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THE CANADIAN PHYTOPATHOLOGICAL SOCIETY /

CANADIAN PLANT DISEASE SURVEY

- DISEASE HIGHLIGHTS

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Diagnostic Laboratories / Laboratoires diagnostiques

CROP: Commercial crops - Diagnostic Laboratory Report

LOCATION: British Columbia

NAME AND AGENCY:
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TITLE: DISEASES DIAGNOSED ON COMMERCIAL CROPS SUBMITTED TO THE BCMAF PLANT DIAGNOSTIC LABORATORY IN 1999.

METHODS: The BCMAF Plant Diagnostic Laboratory provides diagnosis and control recommendations for diseases and disorders of commercial agricultural crops grown in British Columbia. The following data reflects samples submitted to the laboratory by the Ministry extension staff, growers, agribusinesses, parks boards, and master gardeners. Diagnoses were accomplished by microscopic examination, culturing onto artificial media, biochemical identification of bacteria using BIOLOG® and serological testing of viruses and bacteria with micro-well and membrane based Enzyme-Linked Immunosorbent Assay (ELISA). Some specimens were referred to other laboratories for identification or confirmation of the diagnosis. The lab does not do soil or tissue nutrient or chemical residue analysis and has started charging a fee-for-service since the beginning of January 1999.

RESULTS AND COMMENTS: Summaries of the diseases and their causal agents diagnosed on commercial crops are presented in Tables 1-9 by crop category. The total number of submissions for each crop category is listed at the bottom of each table. Problems not listed include: abiotic problems such as nutritional stress, pH imbalance, water stress, poor sample, physiological response to growing conditions, environmental and chemical damage, insect-related injury, and damage where no conclusive disease-causing organism was identified.

Table 1. Summary of diseases diagnosed on **greenhouse vegetable** samples submitted to the BCMAF Plant Diagnostic Laboratory in 1999.

CROP	DISEASE	CAUSAL ORGANISM	NO.
Cucumber	Root rot	*Pythium* sp.	1
	Gummy stem blight	*Didymella bryoniae*	2
Lettuce	Grey mould	*Botrytis cinerea*	1
	Root rot	*Pythium* sp.	1
	Downy mildew	*Bremia lactucae*	2
Pepper	Tomato spotted wilt	Tomato Spotted Wilt Virus	1
	Pepper mild mottle	Pepper Mild Mottle Virus	2
Tomato	Bacterial canker	*Clavibacter michiganensis* subsp. *michiganensis*	1
	Fusarium crown/root rot	Fusarium oxysporum f.sp. radicis-lycopersici	2
	Fusarium wilt	*Fusarium oxysporum* f.sp. *lycopersici*	2
	Pith necrosis	*Pseudomonas corrugata*	1
	Pythium root rot	*Pythium* sp.	1
	Stem canker	*Botrytis cinerea*	1
TOTAL DISEASED SAMPLES			18
TOTAL SUBMISSIONS			31

Table 2. Summary of diseases diagnosed on **floriculture** samples submitted to the BCMAF Plant Diagnostic Laboratory in 1999.

CROP	DISEASE	CAUSAL ORGANISM	NO.
Althea	Anthracnose	*Colletotrichum* sp.	1
Anemone	Foliar nematode	*Aphelenchoides* sp.	2
Antirrhinum majus	Black root rot	*Thielaviopsis basicola*	2
	Root rot	*Pythium*/*Phytophthora* spp.	2
Athyrium felix-femina	Aerial blight	*Rhizoctonia solani*	1
Campanula	Leaf spot	*Phyllosticta* sp.	1
Dahlia	Tomato spotted wilt	Tomato Spotted Wilt Virus	1
Dieffenbachia	Soft rot	*Erwinia chrysanthemi*	1
Dracaena	Root rot	*Phytophthora*/*Rhizoctonia* spp.	1
Dryopteris sp.	Aerial blight	*Rhizoctonia solani*	1
Echinacea	Foliar nematode	*Aphelenchoides* sp.	1
	Root rot	*Pythium* sp.	1
Euphorbia pulcherrima	Stem rot	*Rhizoctonia* sp.	1
	Root rot	*Pythium*/*Phytophthora* spp.	1
Eustoma	Black root rot	*Thielaviopsis basicola*	1
Fuchsia	Black root rot	*Thielaviopsis basicola*	1
Gentiana acaulis	Root rot	*Pythium* sp.	1
Gerbera	Crown rot	*Cylindrocarpon destructans*	1
Hebe	Downy mildew	*Peronospora* sp.	1
Hedera	Root rot	*Pythium*/*Phytophthora* spp.	2
Hydrangea	Root rot	*Pythium* sp.	1
Impatiens	Impatiens necrotic spot	Impatiens Necrotic Spot Virus	1
Iris	Blue mould	*Penicillium* sp.	1
	Bulb rot	*Rhizoctonia* sp.	1
Lavandula	Crown rot	*Rhizoctonia solani*	1
	Root rot	*Phytophthora*/*Pythium* spp.	1
Lilium	Bulb rot	*Rhizoctonia solani*	1
	Foliar blight	*Botrytis cinerea*	1
Narcissus	Basal rot	*Fusarium* sp.	1
	Bulb and stem nematode	*Ditylenchus* sp.	1
	Crown rot	*Rhizoctonia* sp.	2
	Root rot	*Pythium* sp.	2
Osteospermum	Tobacco mosaic	Tobacco Mosaic Virus	1
Pelargonium	Grey mould	*Botrytis cinerea*	2
	Root rot	*Pythium* sp.	2
Petunia	Powdery mildew	*Oidium* sp.	1
	Tobacco mosaic	Tobacco Mosaic Virus	1

cont'd

Table 2. floriculture -cont'd

CROP	DISEASE	CAUSAL ORGANISM	NO.
Phalaenopsis	Root rot	*Pythium*/*Phytophthora* spp.	1
	Root rot	*Rhizoctonia* sp.	1
Polemonium	Foliar nematode	*Aphelenchoides* sp.	1
Polystichum	Aerial blight	*Rhizoctonia solani*	1
Primula	Root rot	*Pythium*/*Phytophthora* sp.	1
Radermachera	Crown & root rot	*Pythium*/*Phytophthora* spp.	1
Rogersia	Foliar nematode	*Aphelenchoides* sp.	1
Tulipa	Blue mould	*Penicillium* sp.	1
Viola	Black root rot	*Thielaviopsis basicola*	2
	Damping-off	*Pythium* sp.	1
	Downy mildew	*Peronospora* sp.	1
Zinnia	Stem canker	*Botrytis cinerea*	1
TOTAL DISEASED SAMPLES			58
TOTAL SUBMISSIONS			104

Table 3. Summary of diseases diagnosed on **small fruit** samples submitted to the BCMAF Plant Diagnostic Laboratory in 1999.

CROP	DISEASE	CAUSAL ORGANISM	NO.
Blackberry	Bacterial blight	*Pseudomonas syringae*	1
	Downy mildew	*Peronospora* sp.	1
Blueberry	Bacterial blight	*Pseudomonas syringae*	12
	Godronia canker	*Godronia cassandrae*	3
	Grey mould	*Botrytis cinerea*	1
	Leaf spot	*Godronia* sp.	1
	Mummyberry	*Monilinia vaccinii-corymbosi*	1
	Root rot	*Phytophthora/Pythium* spp.	1
	Root rot	*Phytophthora* sp.	2
	Stem canker	*Phomopsis* sp.	2
Cranberry	Black rot	*Allantophomopsis* sp.	2
	Black rot	*Allantophomopsis cytisporea*	1
	End rot	*Godronia cassandrae*	1
	Red leaf spot	*Exobasidium* sp.	1
	Leaf spot	*Protoventuria myrtilli*	8
	Root rot	*Pythium/Phytophthora* spp.	1
	Upright dieback	*Phomopsis* sp.	10
Currant	Black root rot	*Thielaviopsis basicola*	1
Raspberry	Crown rot	*Phytophthora/Pythium* spp.	1
	Root rot	*Phytophthora* sp.	6
	Spur blight	*Didymella applanata*	1
Strawberry	Black root rot	*Rhizoctonia & Phytophthora* spp.	2
	Crown rot	*Rhizoctonia solani*	1
	Fruit rot	*Botrytis cinerea*	1
	Leaf spot	*Mycosphaerella fragariae*	1
	Red stele root rot	*Phytophthora fragariae*	3
	Root rot	*Phytophthora* sp.	2
TOTAL DISEASED SAMPLES			58
TOTAL SUBMISSIONS			84

Table 4. Summary of diseases diagnosed on **specialty and minor crop** samples submitted to the BCMAF Plant Diagnostic Laboratory in 1999.

CROP	DISEASE	CAUSAL ORGANISM	NO.
Arnica montana	Crown rot	Cylindrocarpon sp.	1
Basil	Crown rot	*Botrytis* sp.	1
Ginseng	Damping-off	*Rhizoctonia* sp.	1
	Damping-off	*Rhizoctonia solani*	1
	Root rot	*Rhizoctonia solani*	2
	Rusty root	*Cylindrocarpon destructans*	1
Sunflower	White mould	*Sclerotinia sclerotiorum*	1
Thyme	Foliar blight	*Rhizoctonia* sp.	1
Wild Ginger	Stem and crown rot	*Rhizoctonia* sp.	1
TOTAL DISEASED SAMPLES			10
TOTAL SUBMISSIONS			20

Table 5. Summary of diseases diagnosed on **tree fruit** samples submitted to the BCMAF Plant Diagnostic Laboratory in 1999.

CROP	DISEASE	CAUSAL ORGANISM	NO.
Apple	Anthracnose canker	*Cryptosporiopsis curvispora*	2
	Blister spot	Pseudomonas syringae	1
	Crown & root rot	*Phytophthora* sp.	1
	Canker	*Phomopsis* sp.	3
	Cytospora canker	*Cytospora* sp.	1
	Fire blight	*Erwinia amylovora* B	3
	European canker	*Nectria galligena*	1
	Scab	*Venturia inaequalis*	1
Apricot	Bacterial canker	*Pseudomonas syringae*	2
Cherry	Bacterial canker	*Pseudomonas syringae*	10
	Root rot	*Phytophthora*/*Pythium* spp.	1
Grape	Powdery mildew	*Uncinula* sp.	1
Peach	Bacterial canker	*Pseudomonas syringae*	1
	Canker	*Leucostoma* sp.	1
	Canker	*Cytospora* sp.	1
Pear	Canker	*Nectria galligena*	1
	Pear trellis rust	*Gymnosporangium* sp.	1
	Scab	*Venturia* sp.	1
Plum	Bacterial blight	*Pseudomonas syringae*	1
TOTAL DISEASED SAMPLES			34
TOTAL SUBMISSIONS			59

Table 6. Summary of diseases diagnosed on **field vegetable and fruit** samples submitted to the BCMAF Plant Diagnostic Laboratory in 1999.

CROP	DISEASE	CAUSAL ORGANISM	NO.
Broccoli	Downy mildew	*Peronospora parasitica*	1
Cantaloupe	Stem and root rot	*Fusarium oxysporum* f.sp. *radicis-*	2
Carrot	Damping-off	*Rhizoctonia solani*	1
Cauliflower	Root rot	*Phytophthora* sp.	1
	Soft rot	*Pseudomonas* sp.	1
Cucumber	Angular leaf spot	*Pseudomonas syringae*	1
	Black root rot	*Phomopsis sclerotioides*	1
Eggplant	Verticillium wilt	*Verticillium dahliae*	3
Gai Lan/Bok Choy	Leaf spot	*Pseudomonas syringae*	1
Garlic	Bacterial blight	*Pseudomonas* sp.	1
	Blue mold	*Penicillium* sp.	2
	Bulb rot	*Fusarium oxysporum*	1
	White rot	*Sclerotium cepivorum*	1
Lettuce	Soft rot	*Pseudomonas fluorescens*	1
Onion	Rust	*Puccinia porri*	1
	Damping-off	*Rhizoctonia solani*	1
	White rot	*Sclerotium cepivorum*	1
Pea	Crown infection	*Rhizoctonia* sp./*Ascochyta* sp.	1
	Damping-off	*Rhizoctonia* sp.	1
		Pythium sp.	1
	Downy mildew	*Peronospora viciae*	1
	Root rot	*Aphanomyces* sp.	1
Pepper	Impatiens necrotic spot	Impatiens Necrotic Spot Virus	1
Potato	Pythium leak	*Pythium* sp.	3
	oft rot	*Erwinia carotovora* subsp. *carotovora*	3
	Stem canker	*Rhizoctonia solani*	3
	Black scurf	*Rhizoctonia* sp.	1
	Fusarium dry rot	*Fusarium* sp.	1
Rhubarb	Crown and root rot	*Rhizoctonia solani*/*Pythium* sp.	1
Rutabaga	Root rot	*Pythium* sp.	1
Soybean	Root rot	*Pythium* sp.	1
Spinach	Fusarium wilt	*F. oxysporum* f.sp. *spinaciae*	1
Tung Choy	Black root rot/Grey mould	*Thielaviopsis basicola*/*Botrytis cinerea*	1
	Leaf spot	*Pseudomonas syringae*	1
Watermelon	Black root rot	*Thielaviopsis basicola*	1
	Black seedling stems	*Fusarium* sp.	1
	Stem and root rot	*Fusarium oxysporum* f.sp. *radicis-*	1
TOTAL DISEASED SAMPLES			48
TOTAL SUBMISSIONS			68

Table 7. Summary of diseases diagnosed on **woody ornamental** samples submitted to the BCMAF Plant Diagnostic Laboratory in 1999.

CROP	DISEASE	CAUSAL ORGANISM	NO.
Amelanchier	Gymnosporangium rust	*Gymnosporangium* sp.	1
Andromeda	Crown infection	*Phoma & Rhizoctonia* spp.	1
Buxus	Root rot	*Phytophthora/Pythium* spp.	1
Cedrus atlantica	Twig blight	*Sirococcus & Sclerophoma* spp.	1
Cedrus deodara	Tip blight	*Sclerophoma* sp.	1
Cedrus libani	Foliar blight	*Sirococcus & Sclerophoma* spp.	1
Clematis	Leaf spot	*Ascochyta clematidina*	1
	Root rot	*Phytophthora/Pythium* spp.	1
	Stem rot	*Ascochyta clematidina*	2
Cornus alba elegantissima	Spot anthracnose	*Elsinoe corni*	1
	Twig canker	*Nectria cinnabarina*	1
Cyperus	Root rot	*Phytophthora* sp.	1
Daphne odora	Stem rot	*Ascochyta* sp.	1
Elaeagnus	Grey mould	*Botrytis cinerea*	1
Euonymus	Anthracnose	*Colletotrichum* sp.	1
	Leaf spot	*Phyllosticta* sp.	1
Forsythia	Bacterial blight	*Pseudomonas syringae*	1
Fraxinus	Anthracnose	*Discula* sp.	2
Gaultheria	Canker	*Colletotrichum* sp.	1
Ginkgo biloba	Root rot	*Armillaria* sp.	1
Hebe	Vascular wilt	*Fusarium oxysporum*	1
Hibiscus	Stem canker	*Fusarium lateritium*	2
Hydrangea	Leaf spot	*Pseudomonas cichorii*	1
	Powdery mildew	*Erysiphe polygonii*	1
Iberis	Anthracnose	*Colletotrichum gloeosporioides*	1
Ilex crenata	Black root rot	*Thielaviopsis basicola*	1
Juniperus	Root rot	*Phytophthora* sp.	3
	Root rot	*Phytophthora/Pythium* spp.	2
	Twig dieback	*Phomopsis* sp.	1
Juniperus chinensis	Root rot	*Phytophthora* sp.	1
Magnolia soulangiana	Leaf spot	*Phyllosticta* sp.	1
Malus	Anthracnose	*Cryptosporiopsis curvispora*	1
	Bacterial blight	*Pseudomonas syringae*	2
	Rust	*Gymnosporangium* sp.	1
Paxistima	Root rot	*Pythium/Phytophthora* spp.	1
Philadelphus	Bacterial canker	*Pseudomonas syringae*	1
Pinus	Cytospora canker	*Cytospora* sp.	1
Polemonium	Root rot	*Pythium/Phytophthora* spp.	1
Populus	Leaf blight	*Marssonina* sp.	1

cont'd

Table 7. woody ornamental – cont'd

CROP	DISEASE	CAUSAL ORGANISM	NO.
Populus tremuloides	Root rot	*Phytophthora/Pythium* spp.	1
	Stem canker	*Cytospora* sp.	1
Prunus armeniaca	Bacterial blight	*Pseudomonas syringae*	1
Prunus triloba	Bacterial blight	*Pseudomonas syringae*	1
Prunus virginiana	Bacterial blight	*Pseudomonas syringae*	1
	Brown rot	*Monilinia* sp.	1
Pseudotsuga menziesii	Phomopsis canker	*Phomopsis* sp.	1
	Root rot	*Armillaria* sp.	1
	Foliar blight	*Botrytis cinerea*	1
	Seedling blight	*Sirococcus & Sclerophoma* spp.	1
Rhododendron	Anthracnose	*Colletotrichum* sp.	2
	Foliar blight	*Coniothyrium* sp.	1
	Foliar blight	*Phytophthora* sp.	1
	Leaf blotch	*Mycosphaerella* sp.	2
	Root rot	*Phytophthora* sp.	1
Rhododendron impeditum	Root rot	*Phytophthora* sp.	1
Robinia pseudoacacia	Coral spot	*Nectria cinnabarina*	1
Rosa	Root rot	*Phytophthora/Pythium* spp.	1
Sorbus aucuparia	Root rot	*Phytophthora/Pythium* spp.	1
Syringa	Bacterial blight	*Pseudomonas syringae*	5
Syringa patula	Bacterial blight	*Pseudomonas syringae*	1
Syringa prestonae	Bacterial blight	*Pseudomonas syringae*	1
Syringa reticulata	Bacterial blight	*Pseudomonas syringae*	1
Syringa vulgaris	Bacterial blight	*Pseudomonas syringae*	2
	Root rot	*Armillaria* sp.	1
Taxus media	Root rot	*Phytophthora/Pythium* spp.	3
Thuja	Armillaria root rot	*Armillaria* sp.	1
	Foliar blight	*Seiridium* sp.	1
Thuja occidentalis	Foliar blight	*Kabatina thujae*	1
Thuja plicata	Foliar blight	*Kabatina thujae*	1
	Keithia blight	*Didymascella thujina*	1
	Seiridium blight	*Seiridium* sp.	1
	Armillaria root rot	*Armillaria ostoyae*	1
Tsuga heterophylla	Root rot	*Armillaria* sp.	1
Viburnum	Bacterial blight	*Pseudomonas syringae*	1
Wisteria floribunda	Root rot	*Phytophthora* sp.	1
TOTAL DISEASED SAMPLES			91
TOTAL SUBMISSIONS			199

Table 8. Summary of diseases diagnosed on **perennial ornamental crop** samples submitted to the BCMAF Plant Diagnostic Laboratory in 1999.

CROP	DISEASE	CAUSAL ORGANISM	NO.
Alternanthera	Root rot	*Pythium*/*Phytophthora* spp.	1
	Root rot	*Rhizoctonia* sp.	1
Armeria	Leaf blight	*Colletotrichum* sp.	1
Astilbe	Black root rot	*Thielaviopsis basicola*	1
Caryopteris clandonensis	Foliar nematode	*Aphelenchoides* sp.	1
Dicentra	Crown rot	*Pythium*/*Phytophthora* spp.	1
	Crown rot	*Cylindrocarpon* sp.	1
Hosta	Foliar blight	*Botrytis cinerea*	1
Peltiphyllum	Foliar nematode	*Aphelenchoides* sp.	1
Phlox subulata	Stem and leaf blight	*Pyrenochaeta* sp.	1
Sagina subulata	Rust	*Puccinia arenariae*	1
TOTAL DISEASED SAMPLES			11
TOTAL SUBMISSIONS			27

Table 9. Summary of diseases diagnosed on **turfgrass** samples submitted to the BCMAF Plant Diagnostic Laboratory in 1999.

	TYPE OF SAMPLE		
CAUSAL AGENT/DISEASE	Green*	Sod*	Lawn*
Pythium spp./root rot	24	1	
Gaeumannomyces graminis/take-all patch	3	1	
Ascochyta sp./foliar blight	5	1	1
Microdochium nivale/fusarium patch	7		
Typhula sp./snow mould	1		1
Typhula ishikariensis/grey snow mould		1	
Colletotrichum graminicola/anthracnose	16	1	2
Rhizoctonia cerealis/yellow patch	6	2	
Rhizoctonia solani/brown patch		1	
Laetisaria fuciformis/red thread		1	1
Drechslera sp./melting-out		1	1
Basidiomycete/localized dry spot	1		
Algae	5	1	
Sclerophthora sp./downy mildew	23		
Slime mould		1	1
Curvularia sp./foliar blight	2		
Leptosphaerulina sp./leaf spot	1		

*Greens are primarily creeping bentgrass and/or annual bluegrass samples from golf courses.
Lawn and sod refers to mixtures of fescues, ryegrass, Kentucky bluegrass and annual bluegrass.

CROP: Commercial crops – Diagnostic Laboratory Report

LOCATION: Saskatchewan

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TITLE: DISEASES DIAGNOSED ON CROP SAMPLES SUBMITTED TO THE SASKATCHEWAN AGRICULTURE AND FOOD CROP PROTECTION LABORATORY

METHODS: Saskatchewan Agriculture and Food's (SAF) Crop Protection Laboratory provides diagnostic services and recommendations for crop health problems to the agricultural industry. Services include disease, insect and weed identification and testing of weeds for herbicide resistance. Samples are submitted to the Crop Protection Laboratory by SAF Extension Agrologists, growers, agribusiness and home gardeners. Disease diagnosis is accomplished by microscopic examination, culturing on artificial media, ELISA testing and BIOLOG™.

RESULTS: In 1999 the Crop Protection Laboratory received 1041 samples (April 1 – November 19, 1999) of which 80% were for disease diagnosis (a little less than one half of these were for Dutch elm disease). Other than Dutch elm disease, 26% cereals, 3% forages, 4% fruit, 16% oilseeds, 37% special crops, 1% vegetables, 12% woody ornamentals, herbaceous ornamentals and turf comprised the remainder.

Summaries of diseases/causal agents diagnosed on crop samples submitted to the Crop Protection Laboratory in 1999 are presented in Tables 1-8 by crop category.

Table 1: Summary of plant diseases diagnosed on **cereal crops** submitted to the SAF Crop Protection Laboratory in 1999.

CROP	DISEASE/CAUSAL AGENT	NO. OF SAMPLES
Barley	Net blotch/*Pyrenophora teres*	8
	Common root rot/*Cochliobolus sativus, Fusarium spp.*	7
	Fusarium head blight/*Fusarium spp.*	4
	Scald/*Rhynchosporium secalis*	3
	Spot blotch/*Cochliobolus sativus*	3
	Prematurity blight/*Cochliobolus sativus, Fusarium spp.*	2
	Seedling blight/*Cochliobolus sativus, Fusarium sp.*	1
	Seed rot/*Penicillium sp.*	1
	Sooty molds/*Alternaria sp., Cladosporium sp.*	1
	Environmental injury	5
	Herbicide injury	3
	Nutrient deficiency	2
	Physiological/genetic disorder	1
	Mechanical injury	1
Oat	Common root rot/*Fusarium spp.*	1
	Leaf blotch/*Pyrenophora avenae*	1
	Leaf blotch/*Septoria avenae*	1
Wheat	Common root rot/*Cochliobolus sativus, Fusarium spp.*	14
	Septoria leaf blotch/*Septoria tritici, S. nodorum*	11
	Tan spot/*Pyrenophora tritici-repentis*	10
	Head blight/*Fusarium spp.*	8
	Sooty molds/mostly *Alternaria spp., Cladosporium sp.*	8
	Glume blotch/*Septoria nodorum*	7
	Prematurity blight/*Cochliobolus sativus, Fusarium spp.*	4
	Loose smut/*Ustilago tritici*	1
	Seedling blight/*Pythium sp., Fusarium sp. Cochliobolus sp.*	1
	Wheat Streak Mosaic Virus	1
	Herbicide injury	16
	Environmental injury	15
	Nutrient deficiency	4

Table 2. Summary of plant diseases diagnosed on **forage crops** submitted to the SAF Crop Protection Laboratory in 1999.

CROP	DISEASE/CAUSAL AGENT	NO. OF SAMPLES
Alfalfa	Root/crown rot/*Fusarium spp., Rhizoctonia solani, Phoma sp., Pseudomonas sp.*	4
	Black stem/leaf spot/*Ascochyta imperfecta/Phoma medicaginis var. medicaginis*	3
	Environmental injury	2
Russian wild	Head blight/*Fusarium poae*	1
Timothy	Purple spot/*Cladosporium phlei*	2
	Leaf blotch/*Drechslera phlei*	1
	Environmental injury	1
Wheat grass	Stem smut/*Asocystis hypodytes*	1

Table 3. Summary of plant diseases diagnosed on **fruit crops** submitted to the SAF Crop Protection Laboratory in 1999.

CROP	DISEASE/CAUSAL AGENT	NO. OF SAMPLES
Apple	Coral spot/*Nectria cinnabarina*	1
	Scab/*Venturia inaequalis*	1
	Chemical injury	1
Chokecherry	Leaf blister and curl/*Taphrina sp.*	1
	Environmental injury	1
Cherry	Chemical injury	1
Pear	Chemical injury	1
Plum	Plum pockets/*Taphrina communis*	1
Saskatoon	Entomosporium leaf spot/*Entomosporium mespili*	2
	Fireblight/*Erwinia amylovora*	1
	Juniper/saskatoon rust/*Gymnosporangium sp.*	1
	Chemical injury	1
Sea	Physiological stress	1
Strawberry	Root rot/*Rhizoctonia solani*	1

Table 4. Summary of plant diseases diagnosed on **oilseed crops** submitted to the SAF Crop Protection Laboratory in 1999.

CROP	DISEASE/CAUSAL AGENT	NO. OF SAMPLES
Canola	Blackleg/*Leptosphaeria maculans*	11
	Sclerotinia stem rot/*Sclerotinia sclerotiorum*	5
	Damping off/seedling blight/*Pythium* sp.,	-
	Rhizoctonia solani, *Fusarium* spp.	4
	Root rot/*Fusarium spp.*, *Rhizoctonia solani*	6
	Alternaria blackspot/*Alternaria* spp.	2
	Aster yellows phytoplasma	1
	Genetically caused albinism	1
	Grey stem/*Pseudocercosporella capsellae*	1
	Chemical injury	16
	Nutrient deficiency	12
	Environmental stress	6
Flax	Root rot/*Fusarium spp.*, *Rhizoctonia solani*, *Phoma sp.*	3
	Pasmo/*Septoria linicola*	2
	Seed rot/*Pythium sp.*, *Fusarium sp.*	1
	Chemical injury	7
	Environmental injury	2

Table 5. Summary of plant diseases diagnosed on **special crops** submitted to the SAF Crop Protection Laboratory in 1999.

CROP	DISEASE/CAUSAL AGENT	NO. OF SAMPLES
Bean	Seedling blight/*Rhizoctonia solani*, *Cylindrocarpon* sp.	1
	Chemical injury	1
Borage	Sclerotinia stem rot/*Sclerotinia sclerotiorum*	1
Canaryseed	Leaf mottle/*Septoria triseti*	1
	Root rot/*Cochliobolus sativus*	1
	Seedling blight/*Fusarium sp.*, *Cochliobolus sativus*	1
	Chemical injury	2
	Nutrient deficiency	1
Caraway	Alternaria blight/*Alternaria sp.*	2
	Ascochyta blight/*Ascochyta sp.*	2
	Root/crown rot/*Fusarium spp.*	2
Chickpea	Root rot/*Rhizoctonia solani*, *Fusarium spp.*	15
	Ascochyta blight/*Ascochyta rabiei*	7
	Sclerotinia stem rot/*Sclerotinia sclerotiorum*	6
	Botrytis pod rot/*Botrytis cinerea*	3
	Seed rot/*Fusarium sp.*, *Cochliobolus sativus*	1
	Seedling blight/*Fusarium sp.*, *Rhizoctonia solani*	1
	Stemphylium leaf blight/*Stemphylium botryosum*	1
	Chemical injury	2

	Environmental injury	2
Coriander	Alternaria blight/*Alternaria sp.*	6
	Ascochyta blight/*Ascochyta sp.*	3
	Fusarium root rot/*Fusarium spp.*	3
	Fusarium stem rot/*Fusarium sp.*	1
	Environmental injury	1
Echinacea	Root rot/*Fusarium spp., Pythium sp., Rhizoctonia solani*	1
	Root rot/*Fusarium sp.,*	1
	Leaf blight/*Alternaria sp.*	1
Lentil	Ascochyta blight/*Ascochyta lentis*	26
	Root rot/*Fusarium spp., Rhizoctonia solani*	21
	Anthracnose/*Colletotrichum truncatum*	9
	Sclerotinia stem rot/*Sclerotinia sclerotiorum*	7
	Stemphylium leaf blight/*Stemphylium botryosum*	3
	Secondary stem rot/*Fusarium sp.*	2
	Botrytis stem/pod rot/*Botrytis cinerea*	1
	Seed rot/*Pythium sp.*	1
	Seedling blight/*Rhizoctonia solani, Pythium sp.*	1
	Environmental injury	12
	Chemical injury	10
Mustard	Seedling blight/*Rhizoctonia solani*	1
	Staghead/*Albugo candida*	1
	Environmental injury	1
Pea	Mycosphaerella/ascochyta blight/*Mycosphaerella pinodes*	8
	Root rot/*Fusarium spp., Rhizoctonia solani*	5
	Seed rot/bacterial, *Fusarium spp.*	2
	Seedling blight/*Fusarium spp.*	2
	Sclerotinia rot/*Sclerotinia sclerotiorum*	1
	Chemical injury	4
	Environmental injury	4
	Physiological stress	2
Soybean	Chemical	1
	Environmental injury	1
St. John's wort	Excessive moisture	1

Table 6. Summary of plant diseases diagnosed on **vegetable crops** submitted to the SAF Crop Protection Laboratory in 1999.

CROP	DISEASE/CAUSAL AGENT	NO. OF SAMPLES
Corn	Chemical injury	1
Potato	Blackleg/*Erwinia carotovora*	1
	Chemical injury	1

Table 7. Summary of plant diseases diagnosed on **woody ornamental crops** submitted to the SAF Crop Protection Laboratory in 1999.

CROP	DISEASE/CAUSAL AGENT	NO. OF SAMPLES
Ash	Anthracnose/*Apiognomonia errabunda*	1
	Anthracnose/*Gloeosporium aridum*	1
	Canker/*Cytospora sp.*	1
	Chemical injury	1
Crabapple	Scab/*Venturia inaequalis*	3
	Fireblight/*Erwinia amylovora*	1
Chokecherry	Leaf/shoot blight/*Taphrina sp.*	1
	Leaf blister and curl/*Taphrina sp.*	1
	Leaf spot/*Coccomyces hiemalis*	1
Cotoneaster	Chemical injury	1
	Coral spot/*Nectria cinnabarina*	1
	Leaf spot/blight/*Phyllosticta sp.*	1
Elm	Chemical injury	2
Juniper	Twig blight/*Phomopsis juniperovora*	1
	Twig blights/cankers/*Pleospora sp., Cercospora juniperina, Stigmina sp., Glonium sp.*	1
Lilac	Chemical injury	1
Linden	Nutrient deficiency (iron chlorosis)	1
Maple	Tar spot/*Rhytisma acerinum*	1
	Chemical injury	1
	Environmental injury	1
	Nutrient deficiency (iron chlorosis)	1
Mayday	Environmental injury	1
Pine	Scirrhia brown spot/*Scirrhia sp.*	1
	Environmental injury	1
Poplar	Canker/*Valsa sp.*	1
	Leaf spot/canker/*Marssonina sp.*	1
	Chemical injury	1
Prunus sp.	Black knot/Apiosporina morbosa	1
Spruce	Chemical injury	3
	Environmental injury	3

Table 8. Summary of plant diseases diagnosed on **greenhouse and herbaceous ornamental crops** submitted to the SAF Crop Protection Laboratory in 1999.

CROP	DISEASE/CAUSAL AGENT	NO. OF SAMPLES
Petunia	Damping off/*Pythium sp.*	1
Pansy	Nutrient deficiency	1
Snapdragon	Nutrient deficiency	1
Turf	Root rot/*Fusarium spp., Rhizoctonia sp.*	2
	Blister smut/*Entyloma sp.*	1
	Leaf blotch/*Drechslera sp.*	1

CROP: Diagnostic Laboratory Report

LOCATION: Manitoba

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TITLE: 1999 MANITOBA CROP DIAGNOSTIC CENTRE LABORATORY SUBMISSIONS

METHODS: The Manitoba Agriculture and Food Crop Diagnostic Centre provides diagnoses and control recommendations for disease problems of agricultural crops and ornamentals. Samples are submitted by Manitoba Agriculture and Food extension staff, farmers, agri-business and the general public. Diagnosis is based on visual examination for symptoms and culturing onto artificial media.

RESULTS: Summaries of diseases diagnosed on plants in different crop categories are presented in Tables 1-10.

Table 1. Summary of diseases diagnosed **on cereal crops** submitted to the Manitoba Agriculture and Food Crop Diagnostic Centre in 1999.

CROP	SYMPTOM / DISEASE	CAUSAL AGENT
Barley	Net blotch	*Pyrenophora teres*
	Common root rot	*Fusarium* spp.
		Cochliobolus sativus
	Fusarium head blight	*Gibberella zeae, Fusarium* spp.
	Downy mildew	*Sclerophthora macrospora*
	Barley yellow dwarf	Barley yellow dwarf virus (BYVD)
	Septoria leaf spot	*Septoria* spp.
	Damping off	*Fusarium* spp.
	Bacterial leaf blight	*Xanthomonas campestris*
	Leaf rust	*Puccinia hordei*
	Physiological leaf spot	
	Environmental injury	
	Herbicide injury	
Oat	Barley yellow dwarf	Barley yellow dwarf virus (BYDV)
	Bacterial blight	*Pseudomonas syringae*
	Leaf spot	*Septoria avenae*
	Rust	*Pucinnia coronata* f.sp. *avenae*
	Common root rot	*Fusarium graminearum*
	Environmental injury	
	Herbicide injury	
Rye	Ergot	*Claviceps purpurea*

Wheat	Septoria leaf blotch	*Septoria* spp.
	Head blight	*Fusarium* spp.
	Common root rot	*Fusarium* spp.
		Cochliobolus sativus
	Tan spot	*Pyrenophora tritici-repentis*
	Bacterial leaf blotch	*Pseudomonas syringae*
	Barley yellow dwarf	Barley yellow dwarf virus (BYDV)
	Black head mold	*Cochliobolus sativus*
	Damping off	*Fusarium* spp.
	Ergot	*Claviceps purpurea*
	Glume blotch	*Leptosphaeria nodorum*
	Leaf rust	*Puccinia recondita*
	Seedling blight	*Fusarium* spp.
	Powdery mildew	*Erysiphe graminis f. sp. tritici*
	Wheat streak mosaic	Wheat Streak Mosaic Virus (WSMV)
	Herbicide injury	
	Environmental injury	
	Nutrient deficiency	

Table 2: Summary of diseases diagnosed **on forage crops** submitted to the Manitoba Agriculture and Food Crop Diagnostic Centre in 1999.

CROP	SYMPTOM / DISEASE	CAUSAL AGENT
Alfalfa	Root rot	*Fusarium* spp.
	Black stem	*Phoma medicaginis*
	Cercospora leaf spot	*Cercospora zebrina*
	Common leaf spot	*Pseudopeziza medicaginis*
		Peronospora trifoliorum
	Botrytis blossom blight	*Botrytis cinerea*
	Stemphylium leaf spot	*Stemphylium botryosum*
	Leptosphaerulina leaf spot	*Leptosphaerulina briosiana*
	Stem rot	*Sclerotinia sclerotiorum*
	Yellow leaf blotch	*Leptotrochila medicaginis*
	Nutrient deficiency	
	Environmental injury	
	Herbicide injury	
Trefoil	Phyllosticta leaf spot	*Phyllosticta* spp.
	Stemphylium leaf spot	*Stemphylium botryosum*

Table 3: Summary of diseases diagnosed **on fruit crops** submitted to the Manitoba Agriculture and Food Crop Diagnostic Centre in 1999.

CROP	SYMPTOM / DISEASE	CAUSAL AGENT
Apple	Fire blight	*Erwinia amylovora*
	Canker	*Cytospora* sp.
	Apple scab	*Venturia inaequalis*
	Frogeye leaf spot	*Botryosphaeria obtusa*
	Winter injury	
	Iron chlorosis	Nutrient deficiency
Crabapple	Apple scab	*Venturia inaequalis*
	Fireblight	*Erwinia amylovora*
	Canker	*Cytospora* sp.
Chokecherry	Shot hole	*Coccomyces hiemalis*
	Brown rot	*Monilinia fructicola*
	Black knot	*Dibotryon morbosum*
Currant	Powdery mildew	*Sphaerotheca mors-uvae*
Raspberry	Anthracnose	*Elsinoe veneta*
	Fire blight	*Erwinia amylovora*
	Powdery mildew	*Sphaerotheca macularis*
	Nutrient deficiency	
Saskatoon	Brown rot	*Monilinia amelanchieris*
	Canker	*Cytospora* spp.
	Fire blight	*Erwinia amylovora*
	Fusarium root rot	*Fusarium* spp.
	Nectria twig canker	*Nectria cinnabarina*
	Entomosporium spot	*Entomosporium maculatum*
	Environmental injury	
	Nutrient deficiency	
Strawberry	Crown rot, root rot	*Fusarium* spp, *Pythium* spp
	Common leaf spot	*Mycosphaerella fragariae*
	Angular leaf spot	*Xanthomonas fragariae*
	Powdery mildew	*Sphaerotheca macularis*
	Nutrient deficiency	
	Environmental injury	
	Winter injury	
Grape	Downy mildew	*Plasmopora viticola*
	Botrytis blossom blight	*Botrytis cinerea*
Plum	Plum pockets	*Taphrina communis*
	Shot hole	*Coccomyces prunophorae*
	Canker	*Cytospora* sp.

Table 4: Summary of diseases diagnosed **on grass crops** submitted to the Manitoba Agriculture and Food Crop Diagnostic Centre in 1999.

CROP	SYMPTOM / DISEASE	CAUSAL AGENT
Bent grass	Fusarium blight	*Fusarium* spp.
	Melting out	*Drechslera* spp.
Timothy	Brown leaf stripe	*Cercosporidium graminis*
	Purple eye spot	*Heterosporium phlei*
	Aster yellows	Aster yellows phytoplasm
	Environmental injury	
Bluegrass	Root rot	*Fusarium* spp.
	Fusarium patch	*Microdochium nivale*
	Slime mold	*Physarum* spp.
	Nutrient deficiency	
	Septoria leaf blotch	*Septoria* spp.
	Anthracnose	*Colletotrichum graminicola*

Table 5: Summary of diseases diagnosed **on oilseed crops** submitted to the Manitoba Agriculture and Food Crop Diagnostic Centre in 1999.

CROP	SYMPTOM / DISEASE	CAUSAL AGENT
Canola	Blackleg	*Leptosphaeria maculans*
	Downy mildew	*Peronospora parasitica*
	Black spot	*Alternaria* spp.
	Seedling blight, damping off	*Rhizoctonia solani, Fusarium* spp.
	Stem rot	*Sclerotinia sclerotiorum*
	Pythium root rot	*Pythium* spp.
	Fusarium root rot	*Fusarium* spp.
	Anthracnose	*Colletotrichum* sp.
	Aster yellows	Aster yellows phytoplasma
	Herbicide injury	
	Environmental injury	
	Nutrient deficiency	
Flax	Fusarium root rot	*Fusarium* spp.
	Pasmo	*Septoria linicola*
	Fusarium wilt	*Fusarium oxysporum* f. sp. *lini*
	Seed discolouration	*Alternaria* spp.
	Damping off	*Pythium* spp. *Fusarium* spp.
	Sclerotinia stem rot	*Sclerotinia sclerotiorum*
	Environmental damage	

	Herbicide injury	
Sunflower	Sclerotinia wilt	*Sclerotinia sclerotiorum*
	Fusarium root rot	*Fusarium* spp.
	Seed abnormality	*Alternaria zinniae*
	Herbicide injury	

Table 6: Summary of diseases diagnosed **on ornamental trees, shrubs, shade trees and shelterbelts** submitted to the Manitoba Agriculture and Food Crop Diagnostic Centre in 1999.

CROP	SYMPTOM / DISEASE	CAUSAL AGENT
Alpine currant	Root rot	*Fusarium* spp.
Ash	Anthracnose	*Gloeosporium aridum*
	Twig blight/canker	*Cytospora* spp.
	Leaf rust	*Puccinia sparganioides*
Caragana	Leaf spot	*Septoria caraganae*
	Herbicide damage	
Cotoneaster	Fireblight	*Erwinia amylovora*
Elm	Dutch elm disease	*Ophiostoma ulmi*
	Canker	*Cytospora* spp.
	Black spot	*Gnomonia ulmea*
	Coral spot	*Tubercularia ulmea*
	Environmental damage	
	Nutrient deficiency	
Juniper	Phomopsis tip blight	*Phomopsis juniperovora*
Lilac	Powdery mildew	*Microsphaera penicillata*
Maple	Canker	*Cytospora* spp.
	Anthracnose	*Apiognomonia errabunda*
	Environmental injury	
	Herbicide injury	
	Nutrient deficiency	
Oak	Anthracnose	*Gloeosporium quercinum*
	Environmental damage	
	Herbicide injury	
Pine	Needle cast	*Lophodermium* sp.
	White pine blister rust	*Cronartium ribicola*

Poplar	Shoot blight	*Pollaccia* sp.
	Leaf spot	*Septoria* sp.
	Canker	*Cytospora* sp.
	Leaf rust	*Melampsora medusae*
	Herbicide damage	
	Nutrient deficiency	
Russian olive	Canker	*Cytospora chrysosperma*
Spruce	Needle cast	*Rhizosphaera kalkhoffii*
	Cytospora canker	*Leucostoma kunzeii*
	Pythium root rot	*Pythium* sp
	Nutrient deficiency	
	Environmental damage	
Willow	Canker	*Cytospora* spp
	Scab	*Venturia saliciperda*
	Herbicide damage	
	Nutrient deficiency	

Table 7: Summary of diseases diagnosed **on ornamental plants** submitted to the Manitoba Agriculture and Food Crop Diagnostic Centre in 1999.

CROP	SYMPTOM / DISEASE	CAUSAL AGENT
Alyssum	Blossom blight	*Botrytis cinerea*
Coreopsis	Root rot	*Pythium* spp.
Daffodil	Root rot	*Fusarium* spp.
Dahlia	Root rot	*Fusarium* spp.
Hollyhock	Rust	*Puccinia malvacearum*
Iris	Alternaria leaf spot	*Alternaria* spp.

Table 8: Summary of diseases diagnosed **on potato crops** submitted to the Manitoba Agriculture and Food Crop Diagnostic Centre in 1999.

CROP	SYMPTOM / DISEASE	CAUSAL AGENT
Potato	Early blight	*Alternaria solani*
	Root rot	*Fusarium* spp.
	Root rot	*Rhizoctonia solani*
	Late blight	*Phytophthora infestans*
	Fusarium wilt	*Fusarium* spp.
	Verticillium wilt	*Verticillium dahliae*
	Bacterial soft rot	*Erwinia carotovora* subsp. *carotovora*
	Black dot	*Colletotrichum coccodes*
	Net necrosis	Potato leaf roll virus
	Black heart	Physiological stress
	Blackleg	*Erwinia carotovora* subsp. *atroseptica*
	Common scab	*Streptomyces scabies*
	Powdery scab	*Spongospora subterranea*
	Gray mold tuber rot	*Botrytis cinerea*
	Stem rot	*Sclerotinia sclerotiorum*
	Leak	*Pythium* spp.
	Aster yellows	Aster yellows phytoplasma
	Pink rot	*Phytophthora erythroseptica*
	Herbicide injury	
	Environmental damage	

Table 9: Summary of diseases diagnosed **on special field crops** submitted to the Manitoba Agriculture and Food Crop Diagnostic Centre in 1999.

CROP	SYMPTOM / DISEASE	CAUSAL AGENT
American vetch	Rust	*Uromyces* spp.
Corn	Common smut	*Ustilago maydis*
	Fusarium stalk rot	*Fusarium equiseti, F.graminearum, F. moniliforme*
	Nutrient deficiency	
	Environmental injury	
	Herbicide injury	
Chickpea	Ascochyta blight	*Ascochyta* spp.
Echinacea	Aster yellows	Aster yellows phytoplasma
	Fusarium root rot, crown rot	*Fusarium* spp.
Field bean	Root rot	*Fusarium* spp.

	Bacterial blight	*Xanthomonas campestris* pv. *phaseoli*
	Halo blight	*Pseudomonas syringae* pv. *phaseolicola*
	Rust	*Uromyces phaseoli*
	Anthracnose	*Colletotrichum lindemuthianum*
	White mold	*Sclerotinia sclerotiorum.*
	Herbicide injury	
	Environmental damage	
Field pea	Ascochyta blight	*Ascochyta* spp.
	Root rot	*Fusarium oxysporum*
		Fusarium avenaceum
		Fusarium spp., *Rhizoctonia* spp.
	Mycosphaerella blight	*Mycosphaerella pinodes*
	Sclerotinia root rot	*Sclerotinia sclerotiorum.*
	Environmental damage	
Hemp	Sclerotinia stem rot	*Sclerotinia sclerotiorum*
	Blossom and stem blight	*Botrytis* spp.
	Alternaria leaf spot	*Alternaria* spp.
	Nutrient deficiency	
	Environmental injury	
	Herbicide injury	
Lentil	Root rot, seedling blight	Fusarium spp.
	Stem rot	Sclerotinia sclerotiorum
	Anthracnose	Colletotrichum truncatum
	Ascochyta blight	Ascochyta lentis

Table 10: Summary of diseases diagnosed **on vegetable crops** submitted to the Manitoba Agriculture and Food Crop Diagnostic Centre in 1999.

CROP	SYMPTOM / DISEASE	CAUSAL AGENT
Carrot	Pythium root dieback	*Pythium* spp.
Onion	Root rot	*Fusarium* sp.
	Blue mold	*Penicillium* spp.
	Neck rot	*Botrytis aclada*
Squash	Scab	*Cladosporium cucumerinum*
Tomato	Leaf spot	*Septoria* spp.
	Environmental injury	
	Late blight	*Phytophthora infestans*

Cereals / Céréales

CROP / CULTURE: Barley

LOCATION / EMPLACEMENT: Saskatchewan

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TITLE / TITRE: FUSARIUM HEAD BLIGHT OF BARLEY IN SASKATCHEWAN IN 1999.

INTRODUCTION AND METHODS: The incidence of fusarium head blight (FHB) was assessed in 41 2-row and 21 6-row barley fields from 17 crop districts (CDs) in Saskatchewan. Heads from 50 plants, at milk to dough stages, were collected randomly from each field and sent to the Crop Protection Laboratory in Regina for disease assessment, and pathogen isolation and identification. A disease index (percent number of heads affected x mean severity of infection/100) was determined for each field. An average FHB index for infected fields in each CD, and for CDs grouped by soil zone (Zone I=Brown, Zone II=Dark Brown and Zone III=Black/Grey soils) was calculated. Kernels from heads with symptoms were surface sterilized in 10% Javex for 1 minute and plated on potato dextrose agar for identification of *Fusarium* spp.

RESULTS AND COMMENTS: Overall, about two thirds of barley fields surveyed were affected by FHB, a similar proportion to that in 1998, but the average FHB index was slightly lower in 1999 than 1998 (Fernandez et al. 1999). In 1999, the incidence of FHB was lower for 2-row (54% of fields) than 6-row (86%) barley (Table 1). Conversely, the average FHB index was higher for 2-row (1.3%) than 6-row (0.7%) barley. Individual fields with the highest FHB index (2.0% to 5.5%) were found in crop districts 5B and 8A (central- and north-east), 6A and 6B (central) and 9A (north-west). The proportion of affected fields and the average FHB index for those fields were lowest in Soil Zone I in the south-west. The largest proportion of infected fields was in Soil Zone III.

Fusarium poae was isolated from the greatest number of fields, followed by *F. avenaceum* and *F. sporotrichioides* (Table 1). *F. graminearum* was present in few fields. The latter three species were more common in Soil Zone III than in the rest of the province. *Fusarium culmorum* was not isolated from any barley field in 1999.

We gratefully acknowledge the participation of Saskatchewan Agriculture and Food extension agrologists in this survey, and financial support by the Agriculture Development Fund.

REFERENCES:

Fernandez, M.R, G. Holzgang, M.J. Celetti and G. Hughes, 1999. The incidence of Fusarium head blight in barley, common wheat and durum wheat grown in Saskatchewan during 1998. Can. Plant Dis. Surv. 79: 79-82. (HTTP://RES.AGR.CA/LOND/PMRC/REPORT/DISEASE99.HTML)

Table 1. Prevalence and severity (FHB index) of fusarium head blight in 2-row and 6-row barley, and frequency of isolation of *Fusarium* spp. in Saskatchewan in 1999.

	No. affected fields/ total fields		FHB index[1]		*Fusarium* spp.			
Soil zone/ crop district	**2-row**	**6-row**	**2-row**	**6-row**	***avenaceum***	***graminearum***	***poae***	***sporotrichioides***
Zone I								
3A-S	-	1/1	-	<0.1	0	0	0	1
3B-N	1/2	-	0.3	-	0	0	1	0
4A	2/4	-	0.1	-	0	0	0	0
7A	0/2	-	-	-	0	0	0	0
Total or mean	3/8	1/1	0.2	<0.1	0	0	1	1
Zone II								
1A	1/2	2/2	0.2	0.5	1	1	3	1
2A	-	2/2	-	0.1	1	0	1	1
2B	1/2	0/1	0.5	-	0	0	1	0
6A	2/4	1/2	2.7	5.5	1	0	3	1
6B	2/5	0/1	1.7	-	1	0	1	0
7B	2/4	-	0.1	-	0	0	2	0
Total or mean	8/17	5/8	1.2	1.4	4	1	11	3
Zone III								
1B	-	2/2	-	1	1	2	0	1
5A	1/1	2/2	0.4	0.4	1	2	3	2
5B	4/4	4/4	1.6	0.6	4	1	5	4
8A	1/1	-	3.2	-	1	0	1	1
8B	2/3	1/1	0.8	0.3	1	1	1	1
9A	2/3	2/2	2.6	0.2	3	0	1	2
9B	1/4	1/1	0.7	0.1	1	0	1	1
Total or mean	11/16	12/12	1.6	0.5	12	6	12	12
Overall total or mean	22/41	18/21	1.3	0.7	17	7	24	16

[1] FHB index calculated as (percent number of heads affected x mean severity of infection)/100.

CROP / CULTURE: Barley and Oat

LOCATION / EMPLACEMENT: Saskatchewan

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TITLE / TITRE: LEAF DISEASES OF BARLEY AND OAT IN SASKATCHEWAN IN 1999

INTRODUCTION AND METHODS: A survey for leaf diseases of barley and oat was conducted in fields randomly selected from each crop district (CD) in Saskatchewan. Ten flag and ten penultimate leaves were collected at random from 54 barley and 32 oat fields, at the late-milk to dough stages of development, and air dried at room temperature. The percent leaf areas covered by leaf spots and leaf (crown) rust of oat were recorded for each leaf, and an average percent severity calculated for each CD. Identification and quantification of leaf spotting pathogens was done by plating surface-disinfested leaf pieces from each field sample on water agar.

RESULTS AND COMMENTS: Leaf spot diseases were found in all barley and oat fields surveyed (Table 1). Leaf spot severity in individual barley fields ranged from trace (<5%) to severe (>75%), although most had slight to moderate (11-25%) levels of infection. The highest infection levels tended to occur in the central and north-central regions of the province (CDs 6A, 6B, 7A and 8B). All oat fields also exhibited leaf spot symptoms, but at lower severities than barley. Most fields had trace or slight levels of infection. Crown rust was found in about a third of the oat fields sampled at trace or slight levels, except in fields in the southeast (CDs 1A and 1B) where its severity was moderate.

The most common leaf spotting pathogen in barley was *Pyrenophora teres* (data not shown). *Cochliobolus sativus* was the next most common, and was more frequent and widespread than the *Septoria* spp. which tended to be found only in the east-central region (CD 5B). *Pyrenophora avenae* was the most common pathogen isolated from oat leaves, followed by *Septoria* spp. (data not shown). *Cochliobolus sativus* was isolated only rarely.

We gratefully acknowledge the participation of Saskatchewan Agriculture and Food Extension Agrologists in this survey, and financial support by the Saskatchewan Agriculture Development Fund.

Table 1. Distribution and severity of leaf spot diseases in barley and oat and crown/leaf rust in oat in Saskatchewan fields surveyed at the late milk to dough stages in 1999

CROP DISTRICT	BARLEY		OAT			
			Leaf spots		Crown rust	
	# fields affected/ surveyed	Mean severity[1] (%)	# fields affected/ surveyed	Mean severity[1] (%)	# fields affected/ surveyed	Severity[2]
1A	3/3	64	2/2	68	2/2	Moderate
1B	1/1	2	3/3	25	2/3	Slight to moderate
2A	2/2	17	1/1	10		0/1
2B	4/4	23	1/1	17	1/1	Trace
3A-S	1/1	1				
3B-N	2/2	14	1/1	2		0/1
4A	2/2	28	1/1	3		0/1
5A	3/3	7	1/1	2	0/1	
5B	7/7	24	3/3	19	1/3	Trace
6A	5/5	35	2/2	3		0/3
6B	5/5	25	1/1	2		0/1
7A	2/2	49				
7B	4/4	19	2/2	2	1/2	Trace
8A	2/2	2	6/6	18	2/6	Slight
8B	4/4	28	3/3	2		0/2
9A	2/2	7	2/2	42		0/2
9B	5/5	4	3/3	2	1/3	Trace
Total/ Mean	54/54	23	32/32	14	10/32	

[1] Percent flag leaf area infected.
[2] Trace = 1-5%, Slight = 5-10%, Slight to moderate = 11-25%.

CROP / CULTURE: Barley

LOCATION / EMPLACEMENT: Manitoba

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TITLE / TITRE: FUSARIUM HEAD BLIGHT OF BARLEY IN MANITOBA IN 1999

INTRODUCTION AND METHODS:
Seventy-six barley fields in Manitoba were surveyed for the presence of fusarium head blight (FHB) between July 26 and August 17, 1999. The 63 six-row and 13 two-row barley fields were selected randomly along the survey routes. Fusarium head blight incidence (the percentage of infected spikes) in each field was assessed by sampling 50 to 100 barley heads at three locations for disease. Fusarium head blight severity (the average affected proportion of the diseased spikes) was estimated visually in the field. Another estimate of severity was done by collecting 30 infected spikes from 56 of the 76 fields and subsequently counting the number of infected and healthy spikelets on each spike. From these 56 fields, 10 discoloured kernels from five heads per field (50 kernels total) were surface sterilized in 0.3% NaOCl and plated onto potato dextrose agar to determine the *Fusarium* species on the seed.

RESULTS AND COMMENTS:
Conditions were generally favourable for the development of FHB in the early seeded Manitoba crop in 1999. The later seeded crop had a very low levels of FHB. Fusarium head blight was found in all barley fields surveyed. Average incidence of FHB was 26% (range 1 - 62%) and visual estimates of severity in the field averaged 10% (range 1 - 50%). Severity counts of diseased spikelets from the collected spikes averaged 9% (range 0 - 34%). As found in 1998, visual estimates of FHB were generally underestimated in the fields with low severities (< 10%), and overestimated in fields with higher severities (> 15%), compared to actual counts of infected and healthy spikelets. The average FHB Index (Incidence X Severity / 100) was 3.3% (range 0.1 - 23%). Based on these levels of incidence and severity, FHB was estimated to have caused yield losses of 1% in barley in 1999. The *Fusarium* species isolated from infected kernels are listed in Table 1. As in previous years, *F. graminearum* was the dominant species, particularly from more severely infested fields, but other *Fusarium* species, more common in fields with a lower severity of FHB, continued to be a significant component of FHB in barley.

The overall level of FHB in Manitoba barley in 1999 (FHB Index = 3.3%) declined by approximately 50% from the level observed in 1998 (FHB Index = 6.7%). This represents the first year in the last four that the level of FHB on barley did not increase from the previous year.

Table 1. *Fusarium* species isolated from infected barley kernels in Manitoba 1999.

Fusarium spp.	Frequency of fields (%)	Frequency from kernels (%)
F. graminearum	94.6	89.6
F. poae	44.6	5.5
F. sporotrichioides	21.4	1.5
F. equiseti	3.6	0.2
F. avenaceum	17.9	2.3
F. culmorum	3.6	0.8

CROP / CULTURE: Barley

LOCATION / EMPLACEMENT: Manitoba

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TITLE / TITRE: **LEAF SPOTS OF BARLEY IN MANITOBA IN 1999**

INTRODUCTION AND METHODS: In 1999, foliar diseases of barley in Manitoba were assessed by surveying 75 farm fields (11 two-row, 64 six-row barley) from July 26 to August 17 when most crops were at the milky to soft dough stage of growth. Fields were sampled at regular intervals along the survey routes, depending on availability. Disease incidence and severity were recorded by averaging the occurrence of diseases on approximately 10 plants along a diamond-shaped transect of about 50 m per side, beginning near the field edge. Disease ratings were taken on both the upper (flag and penultimate leaves) and lower leaf canopies, using a six-category scale: 0 or nil (no visible symptoms); trace (<1% leaf area affected); very slight (1-5%); slight (6-15%); moderate (16-40%); and severe (41-100%). Infected leaves with typical symptoms were collected at each site, dried and stored in paper envelopes. Surface-sterilized pieces of infected leaf tissue were placed in moist chambers for 3-7 days to isolate and identify the causal agent(s).

RESULTS AND COMMENTS: Conditions in Manitoba in 1999 were generally favourable for development of foliar diseases in early-seeded (late April to early May) cereals, because of regular precipitation. However, conditions were somewhat drier in late July and August, and leaf spot development in the late-seeded crops (mid-May to mid-June seeding, delayed by excessive spring moisture, particularly in south-western regions) was relatively slight. As noted in past reports, the field history, i.e., presence or absence of barley stubble from the previous year, appeared to have a major influence on the level of leaf spotting observed.

Leaf spots were observed in the upper and/or lower leaf canopies of all barley fields surveyed. Disease levels in the upper canopy were nil, trace or very slight in 31% of fields, slight in 53%, moderate in 9%, and severe or leaves senescent in 7%. The distribution of respective severity categories in the lower canopy was 3%, 37%, 25%, and 35%. On this basis, foliar diseases in barley caused little damage in 1999; on average, grain yield losses were likely in the range of 2-3%.

Pyrenophora teres and *Cochliobolus sativus*, causal agents of net blotch and spot blotch, respectively, were the predominant fungi isolated from infected leaf tissue, and each was found in most (92%) fields. *Septoria passerinii* (speckled leaf blotch) was recovered from 23% of fields, while *Colletotrichum graminicola* (anthracnose) and *Rhynchosporium secalis* (scald) were detected in two and one field(s), respectively. Spot blotch is favoured by warm nights, and speckled leaf blotch by drier conditions; therefore in 1999, as also observed in 1998, both diseases were somewhat more prevalent than normal in barley.

CROP / CULTURE: Barley and Wheat

LOCATION / EMPLACEMENT: Alberta

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TITLE / TITRE: DISEASES OF BARLEY AND WHEAT IN EAST-CENTRAL ALBERTA IN 1999

INTRODUCTION AND METHODS: Surveys of barley and wheat for leaf and root diseases were conducted in east-central Alberta farm fields in July 1999, at the flag leaf to heading stages. The survey covered nine municipal districts or counties, including Bonnyville, Lamont, Minburn, Parkland, St. Paul, Sturgeon, Two Hills, Vermilion River and Wetaskiwin. Thirty-seven wheat fields were surveyed from all locations and 11 barley fields from Bonnyville, St. Paul, Two Hills, and Wetaskiwin (Figure 1). Five plants were sampled at each of four random sites for each field. Occurrence of foliar and root diseases was assessed. Plant samples from all surveyed fields were collected and cultured on water agar and acidified potato dextrose agar plates in the laboratory to recover and identify fungal pathogens. Barley yellow dwarf was identified by discoloured leaf symptoms on severely stunted plants.

RESULTS AND COMMENTS: Observations from barley fields are presented in Table 1. Net blotch (*Pyrenophora teres*) was found in most sampled fields. The severity was generally from trace to low. Small patches of stunted plants showing characteristic symptoms of barley yellow dwarf were observed in five barley fields in the Two Hills and Bonnyville areas. The damage caused by this virus disease should be further investigated under field conditions because it has the potential to abort heading or seed development. Other foliar and root diseases observed included spot blotch (*Bipolaris* spp.), alternaria black point (*Alternaria* spp.), common root rot (*Fusarium* spp.) and pythium root rot (*Pythium* spp.), but none caused noticeable damage.

Observations from wheat fields are presented in Table 2. Tan spot (*Pyrenophora tritici-repentis*) was the most common leaf spot disease. It was identified in 29 of 37 wheat fields throughout the survey area, but only at low levels of severity. Common root rot (*Bipolaris* spp.) was the second most prevalent disease found in 11 fields, mostly in the northeast region. Septoria leaf spot (*Septoria* spp.), fusarium foot rot (*Fusarium* spp.) and pythium root rot (*Pythium* spp.) were identified in four fields each. Leaf rust (*Puccinia recondita f.sp. tritici*) and rhizoctonia root rot (*Rhizoctonia solani*) each were found in two fields. Loose smut (*Ustilago tritici*) was noted in only one field.

Table 1. Foliar and root diseases identified in 11 barley fields in east-central Alberta in 1999

Disease	Causal pathogen	No. Fields infested	Location[z]
Net blotch	*Pyrenophora teres*	9	10, 19, 21, 87
Barley yellow dwarf	Barley yellow dwarf virus	5	21, 87
Spot blotch	*Bipolaris* spp.	1	87
Alternaria black point	*Alternaria* spp.	1	87
Loose smut	*Ustilago* nuda	1	87
Common root rot	*Fusarium* spp.	1	87
Pythium root rot	*Pythium* spp.	2	10, 21

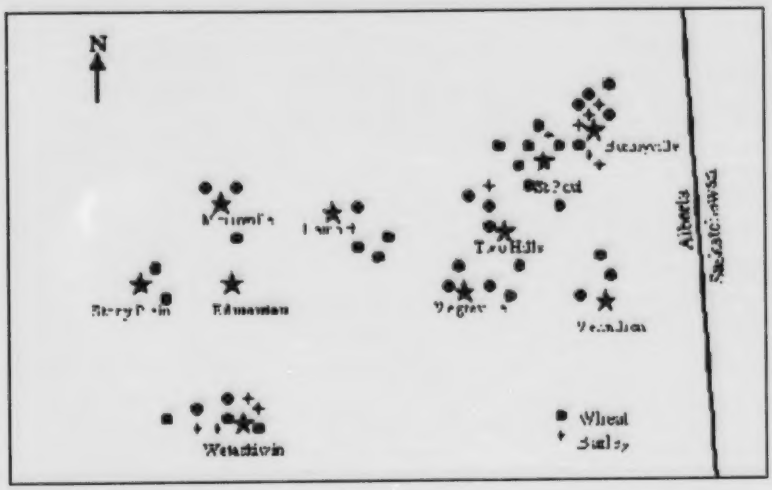
[z] Municipal district or county numbers are Bonnyville No. 87, St Paul No. 19, Two Hills No. 21, and Wetaskiwin No. 10.

Table 2. Foliar and root diseases identified in 37 wheat fields in east-central Alberta in 1999.

Disease	Causal pathogen	No. fields infested	Location[z]
Tan spot	*Pyrenophora tritici-repentis*	29	10, 19, 21, 24, 27, 30, 31,
Septoria leaf spot	*Septoria* spp.	4	21, 30, 87
Leaf rust	*Puccinia recondita f.sp. tritici*	2	10, 87
Loose smut	*Ustilago tritici*	1	19
Common root rot	*Bipolaris* spp.	11	10, 19, 21, 24
Fusarium foot rot	*Fusarium* spp.	4	24, 27, 90
Pythium root rot	*Pythium* spp.	4	10, 19, 30
Rhizoctonia root rot	*Rhizoctonia* solani	2	21, 30

[z] Municipal district or county numbers are Bonnyville No. 87, Lamont No. 30, Minburn No. 27, Parkland No. 31, St Paul No. 19, Sturgeon No. 90, Two Hills No. 21, Vermilion River No. 24, and Wetaskiwin No. 10.

Figure 1. Location of barley and wheat fields surveyed in east-central Alberta in 1999. (Each dot or cross on the map represents one field.)



CROP / CULTURE: Barley, Oat and Wheat

LOCATION / EMPLACEMENT: Manitoba

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TITLE / TITRE: **CEREAL VIRUS DISEASE OUTBREAKS IN MANITOBA IN 1999**

INTRODUCTION AND METHODS: Virus diseases on cereals in Manitoba monitored in 1999 were barley yellow dwarf (BYD), wheat streak mosaic (WSM) and flame chlorosis (FC).

Collaborators identified and collected samples from mid-June to mid-August in cereal crops in Manitoba and parts of eastern Saskatchewan. The proportion of plants with (suspected) virus symptoms in surveyed fields was estimated and specimens with and without symptoms collected for testing. Infection with BYDV and WSMV was confirmed serologically, and for BYDV, also characterized as to serotype, by enzyme-linked immunosorbent assay (ELISA). A subset of samples was also tested by transmission to indicator host plants to assess virulence against historical benchmarks; for WSMV, transmission was by mechanical inoculation to a susceptible spring wheat host, for BYDV, transmission was by cereal aphids to sets of seedlings of a susceptible oat host. Flame chlorosis determinations were by a dot-blot assay to detect FC-specific RNA (1).

RESULTS AND COMMENTS: Barley Yellow Dwarf (BYD) - Wet conditions that delayed seeding in parts of southwestern Manitoba and southeastern Saskatchewan until well into June, set the stage for severe losses, particularly in barley and oat crops. Cereal aphid populations carrying BYDV were in evidence in Manitoba as early as mid-June, one to two weeks earlier than most years. Compared to recent years, a higher proportion of early-arriving cereal aphids were oat bird-cherry (*Rhopalosiphum padi*), the most efficient vector of the predominant BYDV strain, PAV. The proportion of barley fields in western Manitoba with near-total losses due to BYD was the highest observed in recent years. Losses due to BYD in wheat were less extreme but nonetheless significant. In an agronomic trial of 30 advanced wheat lines grown near Brandon where natural disease pressure was intense, yields were reduced 15-50% (median 38%) compared to a trial of the same lines grown near Winnipeg which sustained only moderate disease pressure. Oat cultivars (e.g. Riel, Dumont) that were less than moderately tolerant sustained severe losses if planted later than May 20, but at several locations in southeastern Manitoba susceptible oat cultivars experienced noticeable losses from BYD despite being seeded before May 15. More tolerant cultivars (e.g. AC Assiniboia, AC Rebel) by contrast sustained only moderate losses, even in locations where nearby susceptible barley crops at similar growth stages showed extreme stress from BYD. Consistent with the trend of the last 15-20 years, almost all virus isolates obtained from small grains were of the PAV strain (non-specifically transmitted by the oat bird-cherry aphid).

Wheat Streak Mosaic (WSM) - Localized outbreaks of WSM in spring wheat crops in Manitoba and Saskatchewan in 1999 occurred in the vicinity of infected winter wheat. In affected fields losses were estimated to be between 10 and 20%; the extent of WSM and the losses in affected areas were generally less severe than in 1996, 1997 or 1998. Wheat streak mosaic virus (WSMV) was also infrequently isolated from individual oat plants, perhaps arising from mixed infection with the related oat necrotic mottle virus (ONMV). WSMV in oat does not appear to be a major source of WSMV inoculum that could put spring wheat crops at risk.

Flame Chlorosis (FC) - For the first time since 1985 (when flame chlorosis was recognized as a distinct cereal disease), no instances of FC were observed anywhere in Manitoba. Development of FC depends of slow or delayed germination, and FC has historically (2) been most frequently observed in barley in western Manitoba. With barley seeding in western Manitoba delayed by excessive rainfall until June, soils were warm and moist at seeding, conditions that promote rapid germination.

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CROP / CULTURE: Barley, Oat and Wheat

LOCATION / EMPLACEMENT: Manitoba and Saskatchewan

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TITLE / TITRE: STEM RUSTS OF CEREALS IN WESTERN CANADA IN 1999

INTRODUCTION AND METHODS: Nurseries and production fields of barley, oat and wheat in Manitoba and eastern Saskatchewan were surveyed for the incidence and severity of stem rust (*Puccinia graminis* Pers. f.sp. *tritici* Eriks & Henn. and *Puccinia graminis* f.sp. *avenae* Eriks. & Henn.) during July, August and September of 1999. Infected leaf and stem samples were collected for pathotype identification. Infected samples were also received from cooperators throughout Canada.

RESULTS AND COMMENTS: Conditions for rust infection were generally favorable in 1999 as the growing season was characterized by frequent periods of high relative humidity. Stem rust inoculum did not appear until late in the growing season in southern Manitoba and resulted in generally light infection levels, even on later seeded crops. Commercial wheat fields were not affected by stem rust but late- seeded commercial barley and oat fields had a light incidence of the disease. Some foci of relatively heavy infection were noticed in several commercial oat fields. This indicates that although the level of exogenous inoculum (presumably blown northward from the US) entering some fields was low, conditions for disease development within such fields were good. Susceptible lines of wheat, oat and barley in nurseries had moderate levels of disease late in the season.

P. graminis f.sp. *tritici* pathotypes QCCJN and RCRSK predominated. The continued high level of pathotype QCCJN, which is virulent on commercial barley cultivars, in the pathogen population reinforced the need to incorporate resistance to this pathotype. The most common pathotype of *P. graminis* f.sp. *avenae,* NA67, made up approximately 50% of the isolates from Manitoba and Saskatchewan, a level approximately twice that in the 1998 population. Pathotype NA67 is virulent on all current oat cultivars in western Canada and on most advanced breeding lines. Other pathotypes of *P. graminis* f.sp. *avenae* identified included NA29, NA27, NA30, NA26, and NA25.

CROP: Barley and Wheat

LOCATION: Central Alberta

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TITLE: **CEREAL DISEASE SURVEY IN CENTRAL ALBERTA - 1999**

METHODS: Cereal crops were randomly selected approximately every 10 km in Alberta Census District (CD) 8 (north central Alberta) between July 26 and August 5. This area encompasses Sylvan Lake on the west, Bashaw on the east and is bordered north and south by Ponoka and Innisfail, respectively. Fields were traversed in an inverted V, with analysis of five plants taking place at each of three locations. Leaf diseases were scored on a 0-9 scale, with a 4 rating equal to 1% leaf area diseased (PLAD) on the upper leaf canopy, 5-10 PLAD on the middle canopy and 10-25 PLAD on the lower canopy. Common root rot was assessed on a 0-4 scale where 1=trace and 4=severe. Other diseases were rated as a percent of the crop affected.

RESULTS AND COMMENTS: The results are presented in Table 1. Central Alberta had a relatively wet and cool summer that delayed maturity and increased yields. Thirty-four barley fields were examined, 22 of which were 2-row and 12 were 6-row barley. The number of 2-row fields was unusual as in most years there are twice as many 6-row barley fields as 2-row fields. The leaf diseases scald (*Rhynchosporium secalis*), net blotch (*Pyrenophora teres*) and spot blotch (*Cochliobolus sativus*) were scored higher in the 6-row barley fields, although the leaf disease ratings were relatively low. Common root rot (*C. sativus* and *Fusarium* spp.) levels were low and the disease was not frequently encountered. Loose smut (*Ustilago nuda*) occurred at about the same frequency as in 1998, but in 1999 there were two 6-row fields with high (2-5%) incidence. Barley yellow dwarf (BYDV) and bacterial blight (*Xanthomonas campestris*) occurred at trace levels in one and three fields, respectively. Barley leaf stripe (*Pyrenophora graminea*) is becoming more common in central Alberta with four fields rating ≥1% disease.

In the eight wheat fields surveyed in 1999, disease severity for septoria leaf blotch (*Septoria* spp.) and tan spot (*P. tritici-repentis*) was lower than in 1998. An as yet unidentified leaf spot was noted in one field. Many diseases were absent from the surveyed fields, notably take-all (*Gaeumannomyces graminis*). The early date for the survey may have precluded seeing diseases such as take-all, ergot (*Claviceps purpurea*) and leaf rust (*Puccinia recondita*).

Table 1. Disease incidence and severity in central Alberta cereal fields in 1999.

	# Fields	Average disease rating/number of affected fields*							
		Scald 0-9	Net 0-9	Spot 0-9	CRR 0-4	L Smut %	BLS %	BYD %	BB %
Barley									
2-row	22	3.6/8	3.1/18	2.6/8	0.8/13	tr/7	1.2/3	tr/1	tr/2
6-row	12	3.9/9	3.4/5	3.1/7	0.7/3	1.5/5	1.0/1	0	tr/1

	# Fields	Septoria 0 - 9	Tan Spot 0 - 9	Leaf Spot 0 - 9	CRR 0 - 4
Wheat	8	2.2 / 7	1.9 / 4	6 / 1	0.8 / 4

* Abbreviations: tr=trace amounts (<1%); Net=net blotch; Spot=spot blotch; CRR=common root rot; L Smut=loose smut; BLS=barley leaf stripe; BYD=barley yellow dwarf; BB=bacterial blight.

CROP / CULTURE: Barley, Oat and Wheat

LOCATION / LOCATION: Manitoba and Saskatchewan

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TITLE / TITRE: CEREAL SMUT SURVEYS, 1998 AND 1999

INTRODUCTION AND METHODS: In July 1998 and 1999, cereal crops were surveyed for *Ustilago hordei, U. nigra, U. nuda, U. tritici, U. avenae* and *U. kolleri* in Manitoba and Saskatchewan. The area was covered by routes from, in 1998, Winnipeg - Estevan - Moose Jaw - Saskatoon - Melfort - Yorkton - Brandon - Winnipeg, and in 1999, Winnipeg-Estevan-Moose Jaw-Watrous-Melfort-Yorkton-Brandon, as well as one-day trips around Winnipeg, MB. Fields were selected at random at approximately 10 - 15 km intervals, depending on the frequency of the crops in the area. An estimate of the percentage of infected plants (i.e., plants with sori) was made while walking an ovoid path of approximately 100 m in each field. Levels of smut greater than trace were estimated by counting plants in a one m^2 area at a minimum two sites on the path. *Ustilago nuda* and *U. nigra* were differentiated by observing germinating teliospores with a light microscope.

RESULTS AND COMMENTS:
1998 - Loose smut (*U. tritici*) of bread wheats was found in 10% of the 126 fields surveyed. In most affected fields, levels of infection were 0.01%; the highest level found was 0.1%. In durum wheat, loose smut was found in 41% of the 17 fields surveyed. In most fields, the level of infection was 0.1%, with 0.3% being the highest found. In awned wheats (likely of the CPS wheat class), as in durum wheats, loose smut was common and found in 70% of the 37 fields surveyed. However, the average infection level of 0.25% was higher than in durum, and fields with levels up to 1% were found.

As has been the case for several years, very few oat fields (11% of 46 fields surveyed) had smut. The infection levels in the five positive fields surveyed were 0.1, 0.5, 2, 2 and 10%. The plants infected in oat fields were all infected with *U. avenae* (loose smut).

A high incidence of smut was found in barley with 49% of the 92 fields surveyed containing infected plants. Incidence was particularly high in 6-rowed barley (55% of 69 fields) with most fields having levels of 0.01 to 0.2% smutted plants, but 0.5 to 1% smutted plants per field was not uncommon. The highest level of smut found in 6-row barley was 3%. In 2-row barley, 30% of 23 fields were affected, with five fields having trace levels (0.01%) and the other two fields having levels of 0.1 and 1%. False loose smut (*U. nigra*) and covered smut (*U. hordei*) was found in one and two fields of 6-row barley, respectively. Infected plants in the fields affected with false loose smut or covered smut were at a level of 0.01%. False loose and covered smut infected plants were always associated with loose smut (*U. nuda*) infected plants.

1999 - Loose smut of wheat was found in 17% of the 118 fields of common wheat surveyed. Most affected fields had only trace levels of smut, but one field had 0.1% and another 0.2% smutted plants. In awned wheat fields, 57% of the 14 fields surveyed were infected with smut. Levels ranged from trace to 2%, with an average severity of 0.34%. Sixty-seven percent of the nine durum wheat fields surveyed had smutted plants, most at trace levels. Only one field of durum wheat had a higher level, i.e., 0.2%.

Only one (6%) of 16 surveyed oat fields had smut-infected plants. The oat plants in this field were infected with *U. kolleri* (covered smut) at a severity of 2%.

Thirty nine (65%) of sixty 6-row barley fields and 5 (24%) of twenty-one 2-row barley fields had loose smut infected plants. In the 6-row barley fields, the severity of infection in most fields was trace, but 14 fields had 0.1%, two had 0.5% and one had 1% infected plants. In the 2-row barley fields, the severity of infection was trace in two of the fields, 0.1% in two fields and 0.2% in one field. In 1999, none of the barley fields surveyed was found to have plants infected with false loose smut or covered smut.

In 1999, because of cool wet conditions throughout much of the spring planting period, 'seeding' of cereal crops occurred from late April to mid-June. When the surveys were conducted, maturity in fields in the same district ranged from the boot stage, which is too early to detect smut, to the soft dough stage, which is past the optimum time. This made it very difficult to distinguish infected plants in large parts of the surveyed area. Therefore, the 1999 survey results may not provide an accurate assessment of the incidence and severity of smut diseases on wheat, barley and oat in Manitoba and Saskatchewan.

CROP / CULTURE: Corn

LOCATION / EMPLACEMENT: Ontario and Quebec

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TITLE / TITRE: **SURVEY OF CORN PESTS IN ONTARIO AND QUEBEC**

INTRODUCTION AND METHODS: In August and September 1999, personnel from the Eastern Cereal and Oilseed Research Centre (ECORC) conducted a corn pest survey in Ontario and Quebec. The main purpose was to determine the distribution of the bacterial disease Stewart's wilt (*Pantoea stewartii =Erwinia stewartii*) and of virus diseases, such as Maize Dwarf Mosaic (MDM), Maize Chlorotic Dwarf (MCD), Maize Chlorotic Mottle (MCM), Maize White Line Mosaic (MWLM), Wheat Streak Mosaic (WSM), and Barley Yellow Dwarf (BYD). There is little information in the literature on the occurrence of these diseases and their causal agents on Canadian farms. Also recorded were the distribution and severity of other diseases and insects including eyespot (*Aureobasidium zeae*), northern leaf blight (*Exserohilum turcicum*), common rust (*Puccinia sorghi*), common smut (*Ustilago maydis*), stalk rot (*Fusarium spp.*), ear rot (*Fusarium spp.*), European corn borer (*Ostrinia nubilalis*) and corn rootworm (*Diabrotica longicornis* and/or *D. virgifera*). As well, scouting for any new diseases in Canada was conducted, especially for grey leaf spot (*Cercospora zeae-maydis*).

At each of 69 locations visited between August 19 and September 10, the incidence of each pest and the severity of the predominant pest was recorded. At the same time, Stewart's wilt samples and leaves with virus-like symptoms were collected. If no virus-like symptoms were observed, 10-18 leaves (1 leaf/plant) were randomly collected from the location. ELISA tests for Stewart's wilt, and viruses, were done in the laboratory by using AGDIA antibodies and methods.

RESULTS AND COMMENTS:
Fungal leaf diseases: Eyespot at severe levels was found in Quebec in the counties of Acton, Les Maskoutains, and Montcalm, and in Wellington County, ON. (Table 1); high susceptibility was found in 25 hybrids. Some highly rust-susceptible inbreds were found in nurseries at the University of Guelph, ECORC (Ottawa), and those of seed companies. In hybrids, severe rust symptoms were only found in Renfrew County , ON.; eleven of the hybrids exhibited high susceptibility. Northern leaf blight was found at 28 locations. Seven hybrids appeared to be susceptible to northern leaf blight in Elgin County, ON. One hybrid, grown on 4.4 ha, was highly susceptible at a farm in St-Philippe, Argenteuil County, QC, resulting in a loss of yield of about 20% . Despite this, northern leaf blight was well-controlled on this farm in 1999 as a result of suggested measures taken after observing a major outbreak of the disease in 1998. Physoderma brown spot (*Physoderma maydis*) was found in Elgin County, ON.

Fungal Ear and Stalk Diseases: At several locations, the same 7 hybrids were susceptible to common smut, with more than 25% of plants exhibiting galls, even on the lower nodes. Overall, smut infection in 1999 was lower than that in 1998. Stalk and ear rots were observed at all locations where the corn was mature; at some locations the crop was not mature enough to display rot symptoms. However, several severe outbreaks of stalk rot were reported later in the season in Ottawa-Carleton County, ON and Vaudreuil-Soulanges County, QC. One instance of high susceptibility to ear rot was observed in Vaudreuil-Soulanges County, QC, with more than 30% of the plants having symptoms.

Head smut (*Sporisorium holci-sorghi* = *Sphacelotheca reiliana*) was detected in one field at the Greenbelt Farm, Ottawa, Ottawa-Carleton County, ON. The area affected in 1998 had been about 75 x 30 m^2, but this had expanded to 300 x 100 m^2 in 1999, most likely due to spread during combining. At another location,

Kinburn, head smut caused about a 65% yield loss in a 22 ha field of corn in 1998, but the disease was well controlled in 1999, following management suggestions from ECORC resulting from greenhouse head smut trials. Head smut is a systemic disease, with the symptoms apparent only on the ears and/or tassels, unlike common smut in which galls can occur anywhere on the plant.

Anthracnose top-die back, caused by *Colletotrichum graminicola*, was found at Cobden, Renfrew County and Ottawa, Ottawa-Carleton County, ON. At the Cobden Ontario Corn Committee (OCC) trials, 25 hybrids rated as susceptible had almost 100% diseased plants, while no symptoms were observed on resistant ones. The disease was more predominant in 1999 than other years, possibly due to the drought conditions experienced in these counties in August.

Insects: Severe damage from the European corn borer (ECB) was found at Pakenham, Lanark County, and Kinburn, Ottawa-Carleton County, ON. At Pakenham, one field had an infestation of 70% with 36% of the plants broken. At Kinburn, a non-Bt hybrid had 62% plants with ECB damage while damage was only 6% in a Bt hybrid. No severe damage from corn rootworm was detected at the time of the survey. The corn flea beetle (*Chaetocnema pulicaria*), a vector of Stewart's wilt, was found in southern and eastern Ontario. Aphids and mites were present at most locations; but mite damage was only evident at Mosport, Durham County, ON. Aphids were numerous in Ottawa-Carleton County, ON and Le Haut-Richelieu County and Acton County, QC.

Bacterial and viral diseases: Three bacterial diseases, Stewart's wilt, Goss' bacterial wilt (*Clavibacter michiganensis subsp. nebraskensis* = *Corynebacterium nebraskense*), and Holcus leaf spot (*Pseudomonas syringae*) were found in Ontario in 1999. As shown in Table 1, 'bacterial wilt' was observed at 32 locations, most in southern Ontario. Symptoms differed among locations and with different hybrids. A total of 67 samples with wilt-like symptoms were collected from 32 locations in 12 Ontario and two Quebec counties.

Many symptom-types have been attributed to Stewart's wilt. Seventeen of the samples collected had 'typical' Stewart's wilt symptoms consisting of long streaked lesions with wavy margins; 15 (88%) of these tested positive for Stewart's wilt with the ELISA test. Of the total samples with wilt-like symptoms, 36 (54%) tested positive for Stewart's wilt.

Stewart's wilt was identified in Durham, Elgin, Frontenac, Huron, Kent, Leeds and Grenville, Middlesex, Ottawa-Carleton, Oxford, and Renfrew Counties, ON. No Stewart's wilt was found in Quebec. Very severe levels of Stewart's wilt were found in Elgin and Kent Counties. Twenty-six hybrids were rated as highly susceptible, with more than 40% of the leaf area wilted. Thirty-two hybrids possessed some resistance, having <10% of the leaf area wilted; all other hybrids were rated as intermediate based on symptom development. Red leaf, possibly caused by BYDV, was found at 24 locations, again mainly in southern Ontario. Symptoms of MDM were observed at 3 locations. In total, about 340 plant samples were analysed by ELISA for presence of MDMV-A, B, and O, MCDV-T, MCMV, MWLMV, WSMV, and BYDV-mav and rpv. BYDV-mav was identified at Ottawa, Ottawa-Carleton County and Maynard, Leeds and Grenville County, ON. WSMV also was identified at Ottawa, Ottawa-Carleton County, ON., especially in grain samples with symptoms of kernel red streak. Based on 1999 results, there was no compelling evidence that virus diseases are problematic in corn in Ontario and Quebec.

Overall in 1999, pests of corn were less severe than average, likely as a result of the dry weather in July, August, and September in Ontario and Quebec. However, these conditions favour certain diseases, such as Stewart's wilt and stalk rot.

Table 1: The Distribution of corn pests in Ontario and Quebec in late August-early September, 1999.

COUNTY(S), PROVINCE	Location (s)	Eye-spot	Rust	Blight	Smut	Stalk rot	Ear rot	ECB	CRW	Wilt	Red leaf
Durham, ON	3	3	2	2	2	1		2	2	2*	1
Elgin, ON	3	3	3	2	3	1	1	3	3	3*	1
Frontenac, ON	3	1	2		2	3		1	1	1*	
Huron, ON	3	2	3	2	3		3	3	3	3*	2
Kent, ON	4		4	2	4	1	1	4	4	4*	1
Lanark, ON	2	2	2	2	2	1		2	2		
Leeds and Grenville, ON	9	8	8	3	8	2	1	7	7	7*	3
Middlesex, ON	2	1	2	1	2		1	2	2	2*	
Ottawa-Carleton, ON	7	7	6	2	7	3	2	7	7	3*	3
Oxford, ON	2	2	2	1	2	1	2	2	2	2*	1
Peel, ON	1	1			1			1	1		1
Prescott and Russel, ON	1	1	1	1	1			1	1		
Renfrew, ON	3	3	3	2	3	1	2	3	3	1*	
Stormont Dundas and Glengarry, ON	7	7	7	1	7			7	7		4
Waterloo, ON	1	1	1		1	1	1	1	1	1	1
Wellington, ON	2	1	2		2		1	2	2		1
York, ON	1	1	1		1			1	1	1	1
Acton, QC	3	3	3	3	3		1	3	3	1	1
Argenteuil, QC	1	1	1	1	1			1	1		
Brome-Missiquoi, QC	2	2	1		2		1	2	2		2
D'Autray, QC	1	1	1		1			1	1		
Le Bas-Richelieu, QC	1	1	1	1	1		1	1	1		
Le Haut-Richelieu, QC	1	1			1	1	1	1	1	1	
Les Maskoutains, QC	3	3	2	1	3			3	3		1
Montcalm, QC	1	1	1				1	1	1		
Vaudreuil-Soulanges,	2	2	2	1	1	1	1	2	2		
TOTAL	69	59	61	28	64	17	21	64	64	32	24

Rust = common rust, Blight = northern leaf blight, smut = common smut, ECB = European corn borer, and CRW = corn rootworm. * ELISA test positive for Stewart's wilt. On - Ontario, QC - Quebec

CROP / CULTURE: Oat

LOCATION / EMPLACEMENT: Manitoba and eastern Saskatchewan

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TITLE / TITRE: CROWN RUST OF OAT IN WESTERN CANADA IN 1999

INTRODUCTION AND METHODS: Surveys for oat crown rust (caused by *Puccinia coronata* Cda f. sp. *avenae* Eriks.) incidence and severity were conducted in southern Manitoba from early July to mid-August, and in eastern Saskatchewan in mid-August. Crown rust collections were obtained from wild oat (*Avena fatua* L.) and commercially grown oat in farm fields, and from susceptible and resistant oat lines and cultivars grown in uniform rust nurseries. The nurseries were located at Brandon, Emerson, and Morden, MB, and at Indian Head, SK. The resistant materials in the nurseries included the rust resistant oat cultivars, AC Assiniboia and AC Medallion (both have crown rust resistant genes *Pc38, Pc39,* and *Pc68* combined), and lines with genes *Pc48* and *Pc68* singly or with genes *Pc38, Pc39,* and *Pc48* combined. Virulence phenotypes of single-pustule isolates established from the rust collections were identified, using 16 single-gene backcross lines (*Pc38, Pc39, Pc40, Pc45, Pc46, Pc48, Pc50, Pc51, Pc52, Pc54, Pc56, Pc58, Pc59, Pc62, Pc64, Pc68*) as the primary differential hosts. Single-gene lines with *Pc94* and *Pc96* were included in the differential sets as supplemental differentials.

RESULTS AND COMMENTS: Crown rust was first found in trace amounts in southern Manitoba on July 5. Initially, the disease increased slowly due to cool weather, with infections mainly staying at trace levels even after the third week of July. Early seeded fields of susceptible cultivars (e.g., Robert, Riel, Dumont, AC Marie and AC Preakness) escaped damage. Crown rust then became severe in southern Manitoba and eastern Saskatchewan. By mid-August, moderate to heavy crown rust infections were commonly found on wild oat and in late maturing fields of susceptible cultivars throughout these regions to as far west as Weyburn, SK. Yield and quality damage due to crown rust in the later maturing fields was likely significant. In contrast, cultivars AC Assiniboia, AC Medallion, and Triple Crown had trace to light amounts of crown rust, levels likely too low to cause damage.

To date, 254 single-pustule isolates of *P. coronata* f. sp. *avenae* established from the collections obtained in Manitoba and Saskatchewan in 1999 have been evaluated for their virulence phenotypes using the 18 differential hosts. As in recent years, the prairie rust population is predominated by isolates with virulence to genes *Pc38* and *Pc39*; thus cultivars such as Dumont, Robert, Riel, Belmont, AC Marie and AC Preakness, were susceptible to these isolates. Two percent of the isolates had virulence to genes *Pc38, Pc39,* and *Pc68*, a gene combination found in AC Assiniboia and AC Medallion. Twelve percent of the isolates had virulence to *Pc48*, a gene found in Triple Crown. Genes *Pc94* and *Pc96* are being used in the oat breeding program at the Cereal Research Centre to enhance the crown rust resistance in current cultivars. Two percent of the isolates had virulence to *Pc96*. None of the isolates were virulent to *Pc94*. This gene continues to be highly effective to the *P. coronata* f. sp. *avenae* isolates in Canada as it has been since 1992.

CROP / CULTURE: Durum wheat

LOCATION / EMPLACEMENT: Saskatchewan

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TITLE / TITRE: **LEAF DISEASES OF DURUM WHEAT IN SASKATCHEWAN IN 1999**

INTRODUCTION AND METHODS: A survey for leaf diseases of durum wheat was conducted between the milk and dough stages of growth in 12 crop districts (CD) in Saskatchewan. In each of 38 fields, 10 flag and 10 penultimate leaves were collected at random and air dried at room temperature. Percent leaf area affected by leaf spots was recorded for each leaf. Based on these data, an average percent infection level (severity) was calculated for each field and CD. Surface disinfested leaf pieces were plated on water agar for identification and quantification of leaf spot pathogens.

RESULTS AND COMMENTS: Leaf spots were observed on the flag and penultimate leaves of all durum wheat fields surveyed. In most cases, the penultimate leaves were senescent and percent infection could not be assessed. Leaf spot severities in individual fields ranged from 1% to 23% of the flag leaf infected. Fields with the highest severities (>15% of flag leaf infected) were found in CDs 1A and 2B (southeast), 3AS and 3BS (southwest), 6A (central), and 7A and 7B (west-central) (Table 1).

The most prevalent leaf spot pathogen was *Pyrenophora tritici-repentis* (tan spot), both in the number of fields where it was present and in the percent leaf area colonized (Table 1). The second most commonly isolated pathogen was *Cochliobolus sativus* (spot blotch). The relative frequency of these two fungi was similar to that in the 1998 survey of durum wheat (Fernandez et al. 1999). *Septoria nodorum* (septoria nodorum blotch) was more common in 1999 than 1998. *Septoria tritici* and *S. avenae* f. sp. *triticea* were present in only a few fields.

Leaf rust was found in only two durum wheat fields in CDs 3AS and 6A, at trace levels.

We gratefully acknowledge the participation of Saskatchewan Agriculture and Food extension agrologists in this survey, and financial support from the Agriculture Development Fund.

REFERENCES:
Fernandez, M.R., M.J. Celetti and G. Hughes. 1999. Leaf diseases of common and durum wheat in Saskatchewan in 1998. Can. Plant Dis. Surv. 79: 86-89. (HTTP://RES/AGR/CA/LOND/PMRC/REPORT/DISEASE99.HTML)

Table 1. Distribution and severity of leaf spot diseases, and estimate of the percentage of flag leaf area colonized by leaf spot fungi, in durum wheat fields in Saskatchewan in 1999.

			LEAF SPOT PATHOGENS				
Crop	**No. fields**	**Mean**	***P. tritici-***	***S.***	***S.***	***S. avenae***	***C.***
1A	2/2	13	66/2[2]	-	-	-	31/2
2A	2/2	7	100/2	-	-	-	-
2B	10/10	8	96/10	11/1	-	-	8/1
3A-S	3/3	10	95/3	-	-	-	5/2
3B-N	1/1	4	86/1	-	-	-	-
3B-S	3/3	7	86/3	14/1	-	-	8/2
4A	2/2	1	69/2	31/2	-	-	-
6A	4/4	8	83/4	10/2	4/1	7/1	12/2
6B	2/2	4	84/2	13/1	-	-	8/1
7A	3/3	20	100/3	-	-	-	-
7B	3/3	18	89/3	11/1	22/1	-	1/1
9B	3/3	8	67/3	24/2	29/1	-	-
Mean/total:	38/38	9	87/38	20/10	18/3	7/1	12/11

[1] percent flag leaf area infected.

[2] percent flag leaf area colonized by fungus / number of fields where it occurred.

CROP / CULTURE: Wheat

LOCATION / EMPLACEMENT: Saskatchewan

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TITLE /TITRE: ERGOT IN COMMON AND DURUM WHEAT IN SASKATCHEWAN IN 1999

INTRODUCTION AND METHODS: Regional variety trials (Saskatchewan Advisory Council tests) at 22 locations in Saskatchewan were examined for the presence of ergot (*Claviceps purpurea*) in harvested wheat grain. The number of entries in each of three wheat tests included: 16 Canada Western Red Spring (CWRS), 6 Canada Prairie Spring (CPS) and 8 Canada Western Amber Durum (CWAD). Grain samples from two or three of the tests were obtained from the following locations: 5 in Crop Production Area 1 (Assiniboia, Beverly, Fox Valley, Stewart Valley and Swift Current), 7 in Area 2 (Carlyle, Elrose, Girvin, Kernen, Luseland, Regina, and Weyburn), 8 in Area 3 (Canora, Indian Head, Jedburgh, Kelvington, Melfort, North Battleford, Rosthern and Wynyard) and 2 in Area 4 (Nipawin and Shellbrook). For each entry and location, a composite sample of 150 g from all replicates was analyzed for the presence of ergot bodies. Percent ergot was calculated as (weight of ergot bodies/net weight of samples)X100.

RESULTS AND COMMENTS: Locations where ergot was detected in wheat are listed in Table 1. At all locations, one or more entries from a test would have been downgraded from #1 to #2 because of high ergot levels (Canadian Grain Commission, 1991). Overall, ergot was detected at 55% of the locations. Most locations in Crop Production Area 3 were affected. Girvin, in central Saskatchewan had the highest level of ergot. Average ergot levels were similar in the CWRS and CWAD tests, and slightly lower for the CPS tests.

Average percent ergot in entries varied from 0.01 to 0.10% (Table 2). However, the variation within each was too great to reach any conclusions regarding varietal differences in susceptibility to ergot.

REFERENCES:
Canadian Grain Commission, 1991. Official Grain Grading Guide. 189 pp.

Table 1. Mean percentage of ergot bodies in Canada Western Red Spring, Canada Prairie Spring and Canada Western Amber Durum wheat cultivars planted in regional variety trials in Saskatchewan in 1999.

Crop Production Area	Location	PERCENT (%)[1]			
		Canada Western Red Spring	Canada Prairie Spring	Canada Western Amber Durum	Mean
1	Stewart Valley	0.00	0.01	0.01	<0.01
1	Swift Current	0.03	0.03	<0.01	0.02
2	Girvin	0.32	0.15	0.25	0.27
2	Luseland	0.01	<0.01	0.05	0.02
3	Indian Head	<0.01	0.01	<0.01	<0.01
3	Jedburgh	0.02	0.02	0.02	0.02
3	Kelvington	0.05	0.05	-	0.05
3	Melfort	0.01	<0.01	0.01	0.01
3	North Battleford	-	0.01	0.07	0.05
3	Rosthern	0.03	0.00	0.03	0.02
3	Wynyard	-	0.01	0.01	0.01
4	Nipawin	0.05	0.02	-	0.04
	Mean:	0.05	0.03	0.05	0.04

[1]percent ergot by weight.

Table 2. Mean percentage of ergot bodies in registered wheat cultivars planted in regional variety trials in Saskatchewan in 1999.

CULTIVAR	NUMBER OF TRIAL LOCATIONS	ERGOT
Canada Western Red Spring		
AC Abbey	9	0.03 (0.06)[1]
ab Barrie	9	0.05 (0.09)
AC Cadillac	9	0.03 (0.05)
AC Elsa	9	0.06 (0.13)
AC Intrepid	9	0.06 (0.06)
AC Majestic	9	0.10 (0.21)
AC Splendor	9	0.01 (0.03)
Katepwa	9	0.07 (0.12)
Mackenzie	9	0.07 (0.14)
Prodigy	9	0.03 (0.05)
Canada Prairie Spring		
AC Crystal	11	0.01 (0.02)
AC Karma	11	0.05 (0.05)
AC Vista	11	0.02 (0.03)
Canada Western Amber Durum		
AC Avonlea	10	0.03 (0.05)
AC Morse	10	0.06 (0.12)
AC Navigator	10	0.10 (0.15)
AC Pathfinder	10	0.04 (0.05)
Kyle	10	0.04 (0.09)

[1] percent ergot by weight (standard deviation)

CROP / CULTURE: Wheat

LOCATION / EMPLACEMENT: Saskatchewan

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TITLE/ TITRE: **FUSARIUM HEAD BLIGHT IN COMMON AND DURUM WHEAT IN SASKATCHEWAN IN 1999.**

INTRODUCTION AND METHODS: The incidence of fusarium head blight (FHB) was assessed in 168 common wheat (Canada Western Red Spring and Canada Prairie Spring) and 42 durum wheat (Canada Western Amber Durum) fields from 19 crop districts (CDs) in Saskatchewan. Heads from 50 plants, between milk and dough stages, were collected randomly from each field and sent to the Crop Protection Laboratory in Regina for disease assessment, and pathogen isolation and identification. A disease index (percent number of heads affected x mean severity of infection/100) was determined for each field. An average FHB index for affected fields in each CD, and for CDs grouped by soil zone (Zone I=Brown, Zone II=Dark Brown and Zone III=Black/Grey soils) was calculated. Kernels from heads with symptoms were surface sterilized in 10% Javex for 1 minute and plated on potato dextrose agar for identification of *Fusarium* spp.

RESULTS AND COMMENTS: FHB was found in about half of the wheat fields surveyed in Saskatchewan, a similar proportion to that in 1998, but disease severity was lower in 1999 than in 1998 (Table 1; Fernandez et al., 1999). In 1999, the total percentage of fields where FHB was detected was 53 for common wheat and 57 for durum wheat, while the average FHB index was 0.5% for durum and 1.1% for common wheat. The proportion of infected fields was highest in Zone III and lowest in Zone I. The FHB index was similar in all soil zones for durum wheat and in Zones II and III for common wheat. Individual fields with the highest recorded FHB index (2.0 to 2.2% in durum wheat, 2.0 to 9.6% in common wheat) were found in crop districts 1A (south-east), 5A and 5B (east-central), 6A and 6B (central), 8B (north-east) and 9A and 9B (north-west).

The most commonly isolated *Fusarium* was *F. avenaceum*, followed by *F. poae* and *F. sporotrichioides* (Table 2). *Fusarium culmorum* and *F. graminearum* were present in a few fields. The higher frequency of *F. avenaceum* and lower frequency of *F. graminearum* in 1999 compared to 1998 (Fernandez et al. 1999) could be attributed to cooler conditions during the 1999 growing season.

We gratefully acknowledge the participation of Saskatchewan Agriculture and Food extension agrologists in the survey, and financial support by the Agriculture Development Fund.

REFERENCES:

Fernandez, M.R, G. Holzgang, M.J. Celetti and G. Hughes, 1999. The incidence of fusarium head blight in barley, common wheat and durum wheat grown in Saskatchewan during 1998. Can. Plant Dis. Surv. 79: 79-82. (HTTP://RES.AGR.CA/LOND/PMRC/REPORT/DISEASE99.HTML)

Table 1. Incidence of fusarium head blight and disease severity (FHB index) in common and durum wheat in Saskatchewan in 1999.

Soil Zone	Crop District	COMMON WHEAT		DURUM WHEAT	
		No. fields affected/ total fields	FHB [1] Index	No. fields affected/ total fields	FHB [1] Index
Zone I	3A-S	0/4	-	1/4	<0.1
	3B-N	0/6	-	0/1	-
	3B-S	0/4	-	0/3	-
	4A	-	-	1/2	<0.1
	4B	0/1	-	-	-
	7A	0/5	-	1/3	1.6
Total or mean	-	0/20	-	3/13	0.6
Zone II	1A	9/10	1.8	4/4	0.3
	2A	1/5	0.9	0/2	-
	2B	4/10	0.7	7/11	0.3
	6A	6/11	0.4	2/4	1.3
	6B	4/14	1.8	2/2	0.4
	7B	2/11	0.3	0/3	-
Total or mean	-	26/61	1.2	15/26	0.5
Zone III	1B	3/4	0.6	-	-
	5A	4/6	1.0	-	-
	5B	9/19	0.8	-	-
	8A	13/15	0.4	-	-
	8B	9/13	1.1	-	-
	9A	11/12	2.2	-	-
	9B	11/13	1.2	2/3	0.6
Total or mean	-	60/82	1.1	2/3	0.6
Overall total or mean:		86/163	1.1	20/35	0.5

[1]FHB index calculated as (percent number of heads affected x mean severity of infection)/100.

Table 2. Number of fields where *Fusarium* spp. were isolated from common and durum wheat in Saskatchewan in 1999.

Soil zone/ crop district	No. affected fields	*Fusarium* spp.				
		avenaceum	***culmorum***	***gramin-earum***	***poae***	***sporotrich-ioides***
Zone I						
3A-S	1	1	0	0	0	0
4A	1	0	1	0	0	0
7A	1	1	0	0	1	0
Total:	3	2	1	0	1	0
Zone II						
1A	13	6	0	4	4	8
2A	1	1	0	0	0	0
2B	11	5	0	0	5	5
6A	8	2	0	0	3	5
6B	6	2	1	0	1	3
7B	2	1	0	0	2	0
Total:	41	17	1	4	15	21
Zone III						
1B	3	2	0	1	2	2
5A	4	3	0	0	1	2
5B	9	4	0	1	7	2
8A	13	8	0	0	6	1
8B	9	8	0	0	3	2
9A	11	8	1	0	3	2
9B	13	7	2	0	8	3
Total:	62	40	3	2	30	14
Overall total:	106	59	5	6	46	35

CROP / CULTURE: Wheat

LOCATION / EMPLACEMENT: Manitoba

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TITLE / TITRE: **FUSARIUM HEAD BLIGHT SURVEY OF SPRING WHEAT IN MANITOBA IN 1999**

INTRODUCTION AND METHODS: A survey for fusarium head blight (FHB) in spring wheat fields was conducted in southern Manitoba between 26 July and 10 August 1999. The incidence and severity of FHB in each field were assessed by sampling 50 to 100 wheat heads at three locations in each of 107 fields between watery-ripe and medium dough stages of development (average Zadoks growth stage 81.3). Up to 30 kernels per field from sampled heads were surface-sterilized and incubated on potato dextrose agar under continuous cool white light for 4-5 days to identify the *Fusarium* species present . When more than one *Fusarium* species were present, single spores were grown on carnation leaf agar or synthetic nutrient agar to facilitate identification. The FHB index was calculated as follows: Average incidence X Average severity/100.

RESULTS AND COMMENTS: The disease was present in 95 % of fields. Overall, FHB was less severe in many parts of the province than in the previous six years. Percent heads infected avcraged 15% (ranging from < 1 % to 79%), with average severity of 26 % giving an FHB index of 4.3 % (range <1 to 47%). In 77 % of fields surveyed FHB was found at trace to low levels, with an index averaging only 1.5 % (range 0.07 - 5.2 %). The remaining fields (23 %) sustained average damage of 13.1 % (range 5.5 - 47.5 %). The more severely affected area was in western Manitoba, north of Hwy #1 (around Russell close to the Saskatchewan border). As in past years, the predominant pathogen was *Fusarium graminearum,* one of the main deoxynivalenol producers, and this accounted for over 98% of the isolations (Table 1). Other species found included *F. culmorum, F.avenaceum, F. sporotrichioides, F. oxysporum.* Yield and quality/grade losses were relatively low in Manitoba in 1999.

Table 1. Percent *Fusarium* species isolated from spring wheat in southern Manitoba in 1999.

***Fusarium* spp.**	**PERCENT %**
graminearum	98.3
sporotrichioides	0.3
culmorum	0.1
avenaceum	0.4
unidentified	0.7

CROP / CULTURE: Wheat

LOCATION / EMPLACEMENT: Manitoba

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TITLE / TITRE: 1999 SURVEY OF LEAF SPOT DISEASES OF WHEAT IN MANITOBA.

INTRODUCTION AND METHODS: Surveys for leaf spot diseases of spring wheats were conducted in southern Manitoba between July 26 and August 10, 1999. Leaves were collected from 114 spring wheat fields (103 common, 2 semi-dwarf, 9 unclassified) between heading and soft dough stages of development. Severity of disease on upper and lower leaves was categorized as 0, trace, 1, 2, 3 or 4, with 4 describing dead leaves and 1 lightly affected. Samples of diseased leaf tissue were surface-sterilized and placed in moisture chambers for 5-7 days to promote pathogen sporulation for disease identification.

RESULTS AND COMMENTS: Regular rains in 1999 favoured development of leaf spot diseases which were moderate to severe in southern Manitoba. Disease on the upper leaves was moderately severe averaging 2.7 and severe on lower leaves with levels averaging 3.6. Prevalence of diseases was analyzed for common wheat only as few fields of other types were encountered. Spot blotch, caused by *Cochliobolus sativus* was the predominant leaf spot disease in 1999, occurring in 92 % of fields and accounting for 47.3 % of isolations of pathogenic fungi from foliar lesions (Table 1). The average night temperatures for July in southern Manitoba were 13.8 C, higher than the 30 year mean of 13.4 C. Warm nights and adequate moisture favour spot blotch development (Gilbert et al. 1998). *Septoria tritici* and *S. nodorum* were found in 80 % and 70 % of fields and accounted for 26.4 % and 17.8 % of isolations, respectively. *Septoria avenae* was found at low levels. Tan spot, (*Pyrenophora tritici-repentis*) was found in more than half the fields, but only 8.3 % of isolations were of this fungus. However, in isolations made from leaves of early-seeded plots of spring wheat at Glenlea MB, *P. tritici-repentis* was the principal early-season pathogen.

REFERENCES:

Gilbert, J., S.M. Woods and A. Tekauz. 1998. Relationship between environmental variables and the prevalence and isolation frequency of leaf-spotting pathogens in spring wheat. Can. J. Plant Pathol. 20:158-164.

Table 1. Prevalence and isolation frequency of leaf spot pathogens in 103 fields of common wheat in Manitoba in 1999

	Disease				
	Septoria spp. (Septoria blotches)			*Cochliobolus sativus* Spot blotch	*Pyrenophora tritici-repentis* Tan spot
	S. nodorum	*S. tritici*	*S. avenae*		
Fields (%)	70	80	4.9	92	57
Isolations (%)	17.8	26.4	0.2	47.3	8.3

CROP / CULTURE: Wheat

LOCATION / EMPLACEMENT: Saskatchewan

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TITLE / TITRE: LEAF DISEASES OF COMMON WHEAT IN SASKATCHEWAN IN 1999

INTRODUCTION AND METHODS: A survey for leaf diseases of common wheat was conducted in fields randomly selected from each crop district (CD) in Saskatchewan. Ten flag and ten penultimate leaves were collected at random from 152 common wheat (CWRS, CPS and CWES classes) fields, at the late-milk to dough stages of development, and air dried at room temperature. The percentage of leaf area covered by leaf spots and leaf rust was recorded for each leaf, and an average percent severity calculated for each CD. Identification and quantification of leaf spotting pathogens was done by plating surface-disinfested leaf pieces from each field sample on water agar.

RESULTS AND COMMENTS: Leaf spot diseases were found in all fields surveyed (Table 1). Infection levels for individual fields ranged from 'trace' (1-5% severity) to 'severe' (>75% severity), although, on average, leaf spot severity was slight to moderate in most areas. Leaf spot severity was highest in the north-eastern and central areas of the province (CDs 5B, 6B, 8A, 8B). Leaf rust was widespread throughout the province and was found in over one-half of the fields surveyed, commonly at trace or slight levels. The highest levels were in the south-eastern and east-central regions (CDs 1A, 2A and 5B).

The most prevalent leaf spot disease was tan spot (*Pyrenophora tritici-repentis*), both in the number of fields where it was present and in the percent leaf area infected (Table 2). This was followed by the septoria leaf spot complex (*Septoria tritici*, *Stagonospora nodorum* and *S. avenae* f. sp. *triticea*). *Septoria nodorum* was found at moderate levels throughout most of the province, whereas *S. tritici* was more prevalent and severe in the central and northern areas (CDs 5B, 6A, 6B, 8A, 8B and 9A). Spot blotch (*Cochliobolus sativus)* was the least frequent disease observed.

We gratefully acknowledge the participation of Saskatchewan Agriculture and Food extension agrologists in this survey, and financial support from the Saskatchewan Agriculture Development Fund.

Table 1. Distribution and severity of leaf spot diseases and leaf rust in common wheat in Saskatchewan fields surveyed at the late milk to dough stages in 1999.

	LEAF SPOTS		LEAF RUST	
Crop District	**No. fields affected/ surveyed**	**Severity [1] (%)**	**No. fields affected/ surveyed**	**Severity[2]**
1A	2/2	6	2/2	Slight to moderate
1B	2/2	6	0/2	
2A	4/4	12	4/4	Slight to moderate
2B	8/8	4	3/4	Trace
3A-S	4/4	15	2/4	Slight
3B-N	6/6	6	0/6	
3B-S	3/3	4	0/4	
4A	5/5	1	0/5	
5A	6/6	9	1/5	Trace
5B	19/19	36	16/19	Slight to moderate
6A	11/11	23	11/11	Slight
6B	14/14	12	13/14	Trace
7A	5/5	6	0/5	
7B	11/11	5	0/11	
8A	15/15	40	15/15	Slight
8B	13/13	40	12/13	Trace
9A	11/11	30	6/11	Trace
9B	13/13	21	2/13	Trace
Total/Mean	152/152	15	87/152	

[1] Average percent flag leaf area infected.
[2] Trace = 1-5%, Slight = 5-10%, Slight to moderate = 11-25%.

Table 2. Estimate of the percentage of upper canopy leaf area of common wheat colonized by leaf spot fungi in Saskatchewan fields surveyed in 1999.

Crop District	No. of fields	LEAF SPOT FUNGI[1]				
		P. tritici-repentis	*S. nodorum*	*S. tritici*	*S. avenae f.sp. triticea*	*C. sativus*
1A	2	83/2			17/1	
1B	2	46/2	38/2	12/1	6/1	15 /1
2A	4	58/4	6/4	7/2	10/1	19 /2
2B	3	83/3	23/1	4/1		10 /1
3A-S	4	96/4	11/1			2 /1
3B-N	6	83/6	13/2	12/2	14/1	14 /1
3B-S	3	93/3		10/1		10 /1
4A	5	35/4	37/5	27/4	11/1	8 /1
4B	1	56/1				14 /1
5A	6	55/6	19/4	21/5		11 /4
5B	19	22/18	22/17	44/18	6/7	12/16
6A	11	42/11	9/11	35/11		19 /10
6B	14	44/14	17/9	36/14	8/3	10 /11
7A	5	78/5	26/2		14/1	
7B	11	75/11	25/6		14/6	
8A	15	29/15	28/15	34/13	2/1	10 /15
8B	13	25/13	21/13	48/13		11 /13
0.375	11	15/11	17/11	63/11	1 /1	5 /10
9B	13	58/13	20/13		6 /1	8 /8
Total/Mean	152	47/146	21/117	39/103	7 /17	11 /96

[1] Percentage leaf area colonized by pathogen / number of fields where it occurred. For full names of fungi, see text.

CROP / CULTURE: Wheat

LOCATION / EMPLACEMENT: Manitoba and Saskatchewan

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TITLE / TITRE: **LEAF RUST OF WHEAT IN WESTERN CANADA IN 1999**

INTRODUCTION AND METHODS: Nurseries and commercial fields of wheat in Manitoba and eastern Saskatchewan were surveyed for the incidence and severity of leaf rust (*Puccinia triticina*) during August 1999. Infected leaf samples were collected for pathotype identification by inoculating spores collected from these leaves onto a set of single gene differential host lines.

RESULTS AND COMMENTS: The wheat leaf rust epidemic of 1999 was one of the worst in the last 20 years due to a number of factors: (1) conditions were generally favorable for rust infection with frequent periods of high relative humidity during the growing season; (2) the epidemic in the northern US was their worst in the last 20 years and generated large amounts of inoculum; (3) large areas were seeded to susceptible cultivars; and (4) late seeding due to excessive spring moisture in some areas caused the crop to be very late in maturing, thereby exposing the crop to intense leaf rust pressure. Leaf rust infections were first noticed in Manitoba on June 18. In surveys done during the first week of August leaf rust was found in most fields, but cultivars such as AC Cora and McKenzie continued to have high levels of resistance. Yield loss estimates based on severity levels varied from 5-20% in fields seeded to susceptible cultivars and may have been even greater in those fields seeded late.

The predominant pathotypes of *P. triticina* isolated from Manitoba and Saskatchewan were MBDS, TGBJ, and THBJ. Virulence on *Lr16,* which conditions resistance in the popular cultivar AC Barrie, increased in 1999, a trend that has been developing for a few years. Pathotypes TGBJ and THBJ are virulent on *Lr16*. As a result of this increased level of virulence, *Lr16* should no longer be considered to condition effective leaf rust resistance to the Great Plains *P. triticina* population. Evaluation of isolates from other parts of Canada is in progress.

CROP: Winter Wheat

LOCATION: Manitoba

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TITLE: FUSARIUM HEAD BLIGHT OF WINTER WHEAT IN MANITOBA IN 1999

INTRODUCTION AND METHODS: Thirty-eight fields of winter wheat in southern Manitoba were sampled for the presence of fusarium head blight (FHB) from July 19 to 23, 1999. Because winter wheat is not widely grown in Manitoba (in 1999 it was planted on about 1.4% of the total wheat acreage - Manitoba Crop Insurance Corp.) the farm fields were not surveyed at random; rather, their location was specified by Manitoba Agriculture extension personnel and was confirmed by contacting producers. Fusarium head blight in each field was assessed by non-destructive sampling of a minimum of 100 heads, at each of 3 locations, for percentage of infected spikes (disease incidence), and for average proportion of the head affected (severity). Disease levels were calculated as the 'FHB Index' (% incidence x % severity / 100). The 10 infected heads closest to each of the 3 plant clumps sampled as described above (30 heads in total) were collected at each site to obtain a second estimate of severity (infected spikelets/total spikelets)x 100, for comparison to the field-estimated severity, and for subsequent use in isolating and identifying the pathogen(s).

RESULTS AND COMMENTS: Conditions were generally favourable (adequate and regular precipitation until mid-season) in Manitoba in 1999 for the development of FHB in cereal crops that were seeded (and flowered) early. This would have included winter wheat; however, little FHB developed in winter wheat, less than in 1998 (Tekauz et al. 1999) and less than in spring wheat in 1999 (Gilbert et al. 2000 - this Volume). Most fields sampled were identified by producers as cvs. CDC Clair or CDC Kestrel.

Thirty-six of the 38 fields of winter wheat were affected by FHB; one field had no apparent FHB, another was too ripe to sample as a result of severe leaf rust infection leading to premature senescence. In affected fields, disease incidence ranged from 1 to 6.7% (mean 4.0%), while visual severity was 7 - 90% (mean 15.9%) resulting in an average FHB Index of 0.6%. As such, FHB was estimated to have caused yield losses in commercial winter wheat of about 0.5%. This yield loss is considerably lower than that estimated in 1998, and as such, FHB in winter wheat in Manitoba caused negligible damage in 1999. Severity levels based on collected heads ranged from 11 - 37% (mean 19.7%), providing an average FHB Index of 0.8%.

Determination of the level of *Fusarium* spp. in harvested seed of winter wheat, and the causal species of FHB in the crop, have not been completed, but based on findings for spring wheat in Manitoba in 1999 (Gilbert et al. 2000 - this Volume) *F. graminearum* likely was the principal pathogen.

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CROP / CULTURE: Winter Wheat

LOCATION / EMPLACEMENT: Manitoba

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TITLE / TITRE: **LEAF SPOTS OF WINTER WHEAT IN MANITOBA IN 1999**

INTRODUCTION AND METHODS: In 1999, foliar diseases of winter wheat in Manitoba were assessed by surveying 38 farm fields from July 19 to 23, when crops were at the early milk to soft dough stage. Because winter wheat is not widely grown in Manitoba (in 1999 it was planted on about 1.4% of the total wheat acreage - Manitoba Crop Insurance Corp.) the farm fields were not surveyed at random; rather, their location was specified by Manitoba Agriculture extension personnel and was confirmed by contacting producers. Fields surveyed were located in southern Manitoba, in the area bounded by Hwy #16 and the US border, Brandon in the west and Dugald to the east. Disease incidence and severity were recorded by averaging their occurrence on approximately 10 plants along a diamond-shaped transect of about 50 m per side, beginning near the field edge. Disease ratings were taken on both the upper (usually the flag leaf) and lower leaf canopies, using a six-category scale: 0 or nil (no visible symptoms); trace (<1% leaf area affected); very slight (1-5%); slight (6-15%); moderate (16-40%); and severe (41-100%). Infected leaves with typical symptoms were collected at each site and dried and stored in paper envelopes. Surface-sterilized pieces of infected leaf tissue were placed in moist chambers for 3-7 days to isolate and identify the causal agent(s).

RESULTS AND COMMENTS: Conditions in Manitoba in 1999 for development of cereal foliar diseases were generally favourable in the earlier part (May, June) of the growing season due to adequate and regular precipitation. Thus, winter wheat and early-seeded spring cereals were at greater risk than later-maturing crops.

Leaf spots were observed in the upper and/or lower leaf canopies of all winter wheat fields surveyed. Disease levels in the upper canopy were nil, trace or very slight in 10 % of fields, slight in 16%, moderate in 24%, severe in 32% and leaves senescent in 7%. Respective severity categories in the lower canopy were tabulated as 0%, 8%, 5%, 0% and 87%. Based on symptom development in the upper canopy (>50% of fields categorized to have moderate or severe leaf spotting), foliar diseases in winter wheat in 1999 would have caused damage, resulting in yield and quality losses from smaller, lighter kernels.

Tan spot, caused by *Pyrenophora tritici-repentis*, was found in 79% of fields was the most prevalent disease, followed by spot blotch (*Cochliobolus sativus*) in 47%, septoria nodorum blotch (*Stagonospora nodorum*) in 40%, septoria avenae blotch (*Septoria avenae* f.sp. *triticea*) in 32% and septoria tritici blotch (*Septoria tritici*) in 5%. Based on isolation frequency from infected leaf tissue pieces, *P. tritici-repentis* was the most common leaf spot fungus and comprised 61% of the pathogen population, a greater proportion than the other four pathogens combined (*C. sativus* - 16%, *S. nodorum* - 14%, *S. avenae* f.sp. *triticea* - 1%, *S. tritici* - 8%). As such, much of the leaf spotting and damage observed in winter wheat in Manitoba in 1999 may be attributed to tan spot. This result differs from spring wheat surveyed 2 weeks later, and may reflect seasonal changes in the prevalence of leaf spot pathogens.

FORAGES/ PLANTES FOURRAGÈRES

CROP: Alfalfa (*Medicago sativa* L.)

LOCATION: Northern Alberta

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TITLE: FOLIAR DISEASES OF ALFALFA IN THE PEACE RIVER REGION OF ALBERTA IN 1999

METHODS: Twenty-six alfalfa fields, ranging in age from first- to fifth-year stands, were surveyed in early October, 1999. The survey was conducted in the county of Grand Prairie and three municipal districts, including Smoky River, Birch Hills and Greenview in the Peace River region of Alberta (Fig. 1). Five plants were sampled at each of five random sites at each location, and disease incidence was recorded. Disease severity was not recorded because disease levels were generally low in all fields. Plant samples were collected and diseased portions were cultured on water agar and acidified potato dextrose agar plates in the laboratory to recover fungal pathogens.

RESULTS AND COMMENTS: Yellow leaf blotch (*Leptotrochila medicaginis*) was found in 21 of 26 fields (Table 1). The disease incidence ranged from 4% to 80%. Similar to 1998 (Wang et al., 1999), leptosphaerulina leaf spot (*Leptosphaerulina briosiana*) and spring black stem and leaf spot (*Phoma medicaginis*) were the most commonly observed diseases, but did not cause severe crop damage. Minor leaf diseases noted include anthracnose (*Colletotrichum* spp.), common leaf spot (*Pseudopeziza medicaginis*) and stemphylium leaf spot (*Stemphylium* spp.).

Alfalfa mosaic virus (AMV) was present in 16 fields with an average incidence of 29% (ranging from 8% to 100%) (Table 1). Some AMV hot spots were identified in the region. The most severe spots were located in the County of Smoky River, especially southeast of Falher.

Root rots caused by various soil-borne pathogens (based on root lesion symptoms), were relatively rare in 1999 (*data not presented*) compared to survey results from 1998 (Wang et al., 1999), probably due to drier summer weather.

ACKNOWLEDGEMENT: The authors are thankful for the assistance of Calvin Yoder and Lorraine Harrison of Alberta Agriculture, Food and Rural Development.

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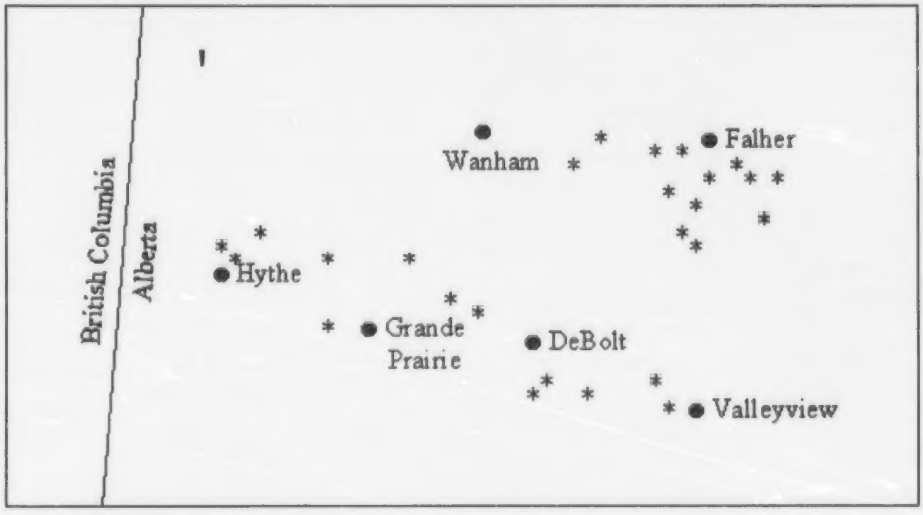
(HTTP://RES.AGR.CA/LOND/PMRC/REPORT/DISEASE99.HTML)

Table 1. Foliar disease incidence in alfalfa fields in the Peace River region of Alberta in 1999

DISEASE	CAUSAL PATHOGEN	NO. OF INFESTED	INCIDENCE (%) in INFESTED FIELDS
Yellow leaf blotch	*Leptotrochila medicaginis*	21	19 (4 – 80)*
Leptosphaerulina leaf spot	*Leptosphaerulina briosiana*	17	44 (12 – 84)
Alfalfa mosaic	Alfalfa mosaic virus (AMV)	16	29 (8 - 100)
Spring black stem and leaf spot	*Phoma medicaginis*	11	13 (4 – 40)
Anthracnose	*Colletotrichum* spp.	5	26 (4 – 60)
Common leaf spot	*Pseudopeziza medicaginis*	3	31 (4 – 72)
Stemphylium leaf spot	*Stemphylium* spp.	2	14 (12 – 16)

* Values in parentheses are the range of disease incidence.

Figure 1. Distribution of surveyed alfalfa fields in the Peace River region of Alberta in 1999.



* Each symbol on the map represents one surveyed field.

CROP: Clover (*Trifolium* spp.)

LOCATION: Alberta

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TITLE: SURVEY OF CLOVER DISEASES IN THE PEACE RIVER REGION OF ALBERTA IN 1998-99.

METHODS: Five clover fields in the municipal district of Smoky River were surveyed in early October 1998. Sixteen fields in the county of Grand Prairie and three municipal districts, including Smoky River, Birch Hills, and Greenview in the Peace River region of Alberta (Fig. 1), were surveyed in early October 1999. Five plants were sampled at each of five random sites at each location and disease incidence was recorded. Disease severity was not recorded because levels were low in all fields. Plant samples were collected and diseased portions were cultured on water agar and acidified potato dextrose agar plates in the laboratory to recover fungal pathogens.

RESULTS AND COMMENTS: Most of the clover fields surveyed were located in the municipal district of Smoky River, near the town of Falher (Fig. 1). Among foliar diseases, northern anthracnose (*Kabatiella caulivora*) was the most prevalent disease in both 1998 and 1999, with an average of 25% and 29%, respectively (Table 1). Powdery mildew (*Erysiphe polygoni*) and spring black stem (*Phoma trifolii*) were also observed at low levels in both years. Stemphylium leaf spot (*Stemphylium* sp.) and fusarium root rot (*Fusarium* spp.) were identified in the 1999 survey. Disease severity levels for all leaf and root diseases were quite low and did not cause significant crop losses.

Mosaic disease was identified in three fields (Table 1). Infection was at trace to mild levels, with disease incidence ranging from 12% to 40%. The exact cause of this disease has not been identified; at least 10 different mosaic viruses infect clover plants worldwide. Further investigation may be needed if the disease becomes more severe.

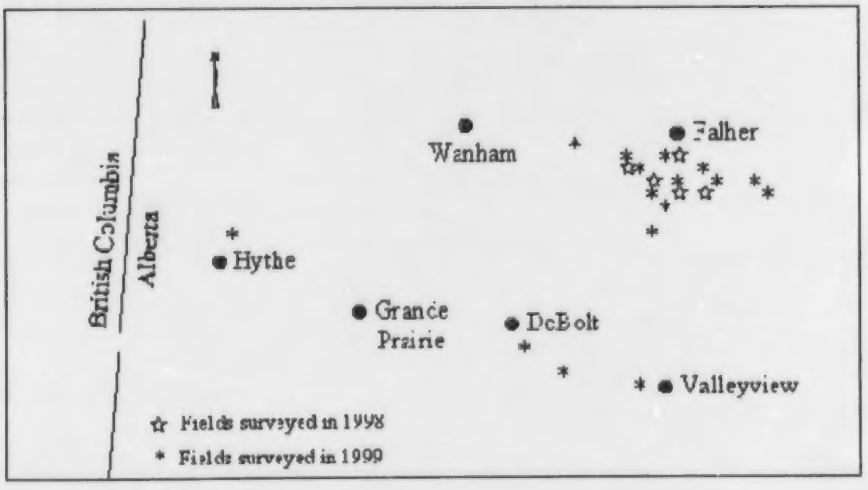
ACKNOWLEDGEMENT: The authors are grateful for the assistance of Calvin Yoder and Lorraine Harrison of Alberta Agriculture, Food and Rural Development.

Table 1. Summary of diseases identified in clover fields in the Peace River region of Alberta in 1998 - 99

DISEASE	CAUSAL PATHOGEN	NO. FIELDS INFESTED	INCIDENCE (%) IN INFESTED FIELDS
1998 survey:			
Powdery mildew	*Erysiphe polygoni*	4	8 (4 – 16)*
Northern anthracnose	*Kabatiella caulivora*	3	25 (20 – 36)
Spring black stem	*Phoma trifolii*	1	4
1999 survey:			
Northern anthracnose	*Kabatiella caulivora*	13	29 (4 – 84)
Powdery mildew	*Erysiphe polygoni*	6	18 (8 – 36)
Stemphylium leaf spot	*Stemphylium* sp.	5	15 (4 – 32)
Spring black stem	*Phoma trifolii*	3	13 (4 – 28)
Fusarium root rot	*Fusarium* spp.	3	13 (8 – 20)
Mosaic	Virus(es)	3	18 (12 – 40)

* Values in parentheses are the range of disease incidence.

Figure 1. Distribution of surveyed clover fields in the Peace Region of Alberta in 1998 – 99.



* Each symbol on the map represents one field surveyed.

CROP: Alfalfa

LOCATION: Saskatchewan

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TITLE: BLOSSOM BLIGHT IN ALFALFA SEED FIELDS IN SASKATCHEWAN, 1999.

METHODS: The incidence of blossom blight [*Botrytis cinerea*, *Sclerotinia sclerotiorum*] in commercial alfalfa seed fields in Saskatchewan was assessed in July 1999. Twenty-seven fields, representing the main alfalfa seed production areas of Saskatchewan, were sampled for blossom infestation at 7-10 day intervals during flowering. Selected alfalfa seed producers did the sampling and assessment for most of the sites using a test kit and manual developed at Saskatoon (Can. J. Pl. Pathol. 21(4): 197), and provided us with their assessments. For each sample, 40 mature alfalfa blossoms were collected and plated onto a semi-selective agar, without surface sterilization. After 5-10 days of incubation, colonies of *B. cinerea* and *S. sclerotiorum* were counted and the percentage infestation with each pathogen was calculated. Observations were summarized over early and late bloom periods for each site, then within each region.

RESULTS AND COMMENTS: Weather conditions in June and early July were generally cool and wet. As a result, flowering was delayed until mid-July in many areas. Mean levels of both pathogens were low (Table 1). *Sclerotinia sclerotiorum* was the dominant pathogen at every site, but only seven fields showed severe infestation (≥ 45%). *Botrytis cinerea* was present at low levels in many fields. Infestation incidence remained relatively constant between the first and second sampling dates, despite warmer and drier conditions in mid to late July.

ACKNOWLEDGEMENT: Thanks to the Saskatchewan Alfalfa Seed Producers Association for assistance with placing the kits with growers and to the Agri-Food Innovation Fund for partial funding of the project.

Table 1. Mean flower infestation (and range) with *Botrytis cinerea* or *Sclerotinia sclerotiorum*, assessed at early and late bloom in commercial alfalfa seed production fields in Saskatchewan, 1999.

Region	No. fields assessed	EARLY BLOOM		LATE BLOOM	
		B. cinerea	*S. sclerotiorum*	*B. cinerea*	*S. sclerotiorum*
Northern grainbelt	20	5% (0-28)	28% (0 -77)	5% (0 -30)	26% (0 -65)
Central grainbelt	5	2% (0-4)	29% (21-45)	15% (10-19)	21% (16-25)
Southeast grainbelt	2	0%	30% (25-35)	0%	21% (13-28)

OILSEEDS AND SPECIAL CROPS / OLÉAGINEUX ET CULTURES SPÉCIALES

CROP: Dry Bean

LOCATION: Southern Alberta

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TITLE: SURVEY OF DISEASES OF DRY BEAN IN SOUTHERN ALBERTA IN 1999

METHODS: Twenty-two irrigated crops of dry bean were surveyed for diseases on September 2-3, 1999 in the bean production areas surrounding Bow Island and Taber, Alberta. Each crop was sampled by selecting ten sites in a U-shaped pattern, approximately 20 m apart, with each site consisting of a 3 m long section of row (Howard and Huang, 1983). The percentage incidence of plants with white mold, gray mold, and bacterial blights was calculated for each crop by averaging the results at the ten sites. The incidence of each disease was categorized for each crop according to the following scale: (1) none (0% of plants infected), (2) trace (<1%), (3) light (1-10%), (4) moderate (11-25%), (5) high (26-50%), (6) very high (>50%).

RESULTS: Diseases of dry bean detected in 1999 were white mold (*Sclerotinia sclerotiorum*), gray mold (*Botrytis cinerea*) and bacterial blights (*Xanthomonas campestris* pv. *phaseoli*, *Pseudomonas syringae* pv. *phaseolicola*). White mold was found in all of the bean crops surveyed with incidence ranging from 1 to 47%. The frequency of crops with light, moderate and high incidence of white mold was 59%, 27% and 14%, respectively.

Gray mold was present in 14 of the 22 crops with incidence ranging from 0 to 11%. The frequency of crops with trace, light and moderate incidence of gray mold was 50%, 9% and 5%, respectively. The disease was found throughout the survey area. Bacterial blights were present in 17 of the crops with incidence ranging from 0 to 20%. The frequency of crops with trace, light and moderate incidence of bacterial blights was 36%, 27% and 14%, respectively. Both common blight (*X. campestris* pv. *phaseoli*) and halo blight (*P. syringae* pv. *phaseolicola*) were present in the surveyed area.

DISCUSSION: White mold, gray mold and bacterial blights have been previously reported as major diseases of dry bean in southern Alberta (Huang and Erickson, 1994; Huang et al., 1995; Huang et al., 1996; Huang and Erickson, 1999). The same diseases continue to be found throughout the dry bean production area. White mold was the most serious disease in 1999, as in previous years.

The presence of gray mold and bacterial blights at low levels throughout the dry bean production area of southern Alberta suggests that these diseases have the potential to become a serious problem given appropriate conditions.

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CROP: Field bean

LOCATION: Manitoba

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TITLE: DISEASES OF FIELD BEAN IN MANITOBA IN 1999

METHODS: Crops of field bean were surveyed for root diseases at 42 different locations and for foliar diseases at 29 locations in Manitoba. The survey for root diseases was conducted in the third week of July when plants were at the 1-3 node stages, and for foliar diseases was conducted in the last week of August when the plants were at the pod-fill to early maturity stages. The crops surveyed were chosen at random from regions in southeast and south-central Manitoba, where most field bean is grown. Ten plants were sampled at each of three random sites for each crop surveyed. Diseases were identified by symptoms. The severity of root diseases was estimated using a scale of 0 (no disease) to 9 (whole roots/lower stem severely diseased). Five to ten roots with disease symptoms per field were collected for isolation of fungi in the laboratory in order to confirm the visual assessment. Severity of foliar diseases was estimated using a scale of 0 (no disease) to 5 (whole plants severely diseased). White mould was rated as a percentage of plants infected.

RESULTS AND COMMENTS: Root rots were observed in all 42 fields surveyed and a total of four diseases were recorded (Table 1). Of the four diseases, rhizoctonia root rot (*Rhizoctonia solani*) and fusarium root rot (*Fusarium solani* f. sp. *pisi*) were the most prevalent, and were observed in 26 and 23 of the 42 fields surveyed, respectively. The average severity for rhizoctonia root rot was 1.5 and for fusarium root rot was 1.4 on the 0-9 scale. Severe infection by either disease was not observed. Other root diseases including pythium root rot (*Pythium* spp.), aphanomyces root rot (*Aphanomyces euteiches*) and those caused by unidentified pathogens were minor and each was observed once only.

Four foliar diseases were observed in the 29 fields surveyed (Table 2). Bacterial blights including common bacterial blight (*Xanthomonas campestris* pv.*phaseoli*), halo blight (*Pseudomonas syringae* pv. *phaseolicola*) and bacterial brown spot (*Pseudomonas syringae* pv. *syringae*) were observed in all 29 fields surveyed and were the most severe diseases of field bean in Manitoba in 1999. Yield reduction due to bacterial blights was estimated to be at least 10%. White mould (*Sclerotinia sclerotiorum*) was observed in 6 fields but only one crop was severely infected (50%). Other diseases including rust (*Uromyces appendiculatus*) and anthracnose (*Colletotrichum lindemuthianum*) were observed in 5 and 4 crops, respectively. These diseases did not appear to cause significant damage to the field bean crops.

The Manitoba Agriculture Crop Diagnostic Centre received 55 samples of field bean. Of these samples, 36 were common bacterial blight, 1 halo blight, 7 fusarium root rot, 1 rust, 2 white mould, 2 herbicide injury, and 6 environmental damage.

Table 1. Intensity of root disease in 42 crops of field bean in Manitoba in 1999.

Disease	No. fields affected	DISEASE INTENSITY IN AFFECTED FIELDS*	
		Mean	Range
Aphanomyces root rot	1	2.8	2.8
Fusarium root rot	23	1.4	0.1-2.8
Pythium root rot	1	0.2	0.2
Rhizoctonia root rot	26	1.5	0.3-5.2
Unknown	1	2	1.0-3.0

*Disease intensity was rated on a scale of 0 (no disease) to 9 (whole roots severely diseased).

Table 2. Intensity of foliar diseases in 21 crops of field pea in Manitoba in 1999.

Disease	No. fields affected	DISEASE INTENSITY IN AFFECTED FIELDS*	
		Mean	Range
Bacterial blights	29	1.8	1.0-5.0
White mould (%)	6	9.8	0.5-50.0
Rust	5	1.8	1.0-5.0
Anthracnose	4	1	1

*White mould was rated as percent plants infected; other diseases were rated on a scale of 0 (no disease) to 5 (whole plant severely diseased).

CROP: Sugar beet

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TITLE: SURVEY OF DAMPING-OFF DISEASES OF SUGAR BEET IN SOUTHERN ALBERTA in 1999

INTRODUCTION: Sugar beet is an important crop for rotation with cereals and legumes and for crop diversification in western Canada. Contracted area for sugar beet production in southern Alberta has increased from 12,000 ha in 1988 to 16,900 ha in 1998 with a root yield of 959,300 tonnes in 1998 (Chaudhary 1998). Sugar beet is highly susceptible to damping-off pathogens such as *Pythium* sp. "group G", which is widespread in southern Alberta (Huang *et al.* 1992). A survey of damping-off diseases of sugar beet in southern Alberta was conducted in 1999.

METHODS: Twenty-five crops of sugar beet were surveyed for damping-off diseases between June 29 and July 5. The survey covered the sugar beet growing area of southern Alberta, from Picture Butte to Bow Island and south to Foremost. Each crop was sampled by selecting12 sites, 4.5 m in length, from four rows. The rows were approximately 30 m apart from one another and the three 4.5 m sites per row were 20 m apart in the row. Due to the precision seeding used in commercial production of sugar beet in Alberta (one seed per 15 cm), a 4.5 m site should consist of 30 plants. The number of plants emerged per site was recorded and the percentage emergence was calculated for each crop. Ungerminated seeds were collected from areas with low emergence in order to determine the causal agent. The collected seeds were washed in sterile water, surface sterilized in 70% ethanol for 2 min. and plated on potato dextrose agar (PDA). Fungi isolated from the seeds were purified on PDA and the genus of each fungus isolated was determined based on morphological characteristics.

RESULTS and DISCUSSION: Seedling emergence varied among and within crops. Of the 25 crops surveyed, seedling emergence was less than 60% in 5 crops, 60 to 80% in 13 crops and more than 80% in 7 crops. At the time of survey, it was often difficult to attribute the cause of low emergence and patchiness within the crops with a specific disease because most of the plants were past the seedling stage and averaged 7-10 true leaves. Therefore, future surveys for damping-off diseases will have to be performed earlier in the season. The fungus *Rhizoctonia solani* was found in three of the crops, one low emergence crop (57%) and two patchy crops averaging 62% and 68% emergence. Three of the crops with less than 60% plants emerged had high weed/volunteer infestations which could explain the low seedling emergence. The cause of poor emergence (53%) of one crop was attributed to an infestation of wireworms, the larvae of click beetles. These larvae were also found in a crop with an averaged emergence of 66%, but the low frequency of larvae recovered suggests that the infestation may not have been the only reason for low emergence in this crop.

The fungi *Fusarium* spp. were isolated from many of the ungerminated seeds collected from crops that averaged emergence levels of 60-80%. No attempt was made to identify the species and verify the pathogenicity of *Fusarium* spp. Previous reports (Harveson and Rush 1998; Ruppel, 1991) showed that *Fusarium oxysporum* f. sp. *betae* was a damping-off pathogen of sugar beet.

Another damping-off pathogen, *Pythium ultimum*, was not isolated in seed samples in our survey although earlier surveys of field soil samples indicated that *Pythium ultimum* "group G" was widespread in sugar beet in southern Alberta (H.C. Huang, unpublished data). It is possible that some of the missing plants in the crops surveyed was due to *Pythium* pre-emergence or post-emergence damping-off. However, the survey was performed too late to find any sign of this pathogen.

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CROP: Canola

LOCATION: Manitoba

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TITLE: DISTRIBUTION, PREVALENCE AND INCIDENCE OF CANOLA DISEASES IN MANITOBA (1999)

METHODS: In August and September, 235 canola crops were surveyed in the eastern/interlake (47), southwest (60), northwest (57) and central (71) regions. All crops were *Brassica napus*. All crops were assessed for the prevalence (percent crops infested) and incidence (percent plants infected per crop) of sclerotinia stem rot (*Sclerotinia sclerotiorum*), aster yellows (phytoplasma), staghead (*Albugo candida*), foot rot (*Fusarium* spp. and *Rhizoctonia* sp.) and blackleg (*Leptosphaeria maculans*). Blackleg lesions that occurred on any part of the stem were assessed separately from basal stem cankers. The prevalence and percent severity of alternaria pod spot (*Alternaria* spp.) was determined.

In each canola crop, 100 plants were selected in a regular pattern starting at a corner of the field or at a convenient access point. The edges of the fields were avoided. Twenty plants were sampled at each of five points of a "W" pattern in the field. Points of the "W" were at least 20 paces apart. The plants were pulled up, removed from the field and examined for the presence of diseases.

RESULTS: Sclerotinia stem rot, blackleg and alternaria pod spot were the most prevalent diseases throughout the province (Table 1). The prevalence of sclerotinia-infested crops ranged from a high of 64% in the eastern/interlake region to 53% in the southwest region with a provincial mean of 60%. This differed from a prevalence of 82% in 1998 (McLaren and Platford, 1999). Mean disease incidence ranged from 10% in the eastern/interlake region to 6% in the southwest region. The provincial mean of 8% was less than in 1998 and would result in about a 4% yield loss. In 1999, moist conditions during late June and July were favourable for the development of sclerotinia. However, in late July and early August, hot dry weather lowered the risk of stem rot in many areas.

Blackleg basal cankers occurred in 70% of the crops surveyed in 1999 with disease incidence ranging from 29% in the southwest region to 6% in the eastern/interlake region and with a provincial mean of 18%. The average incidence was lower in 1998, with the highest value of 16% occurring in the central region (McLaren and Platford, 1999). When blackleg was detected in crops in 1999, basal cankers were observed in many cases. These caused a yield loss estimated at about 12% on a province-wide basis.

The mean prevalence of blackleg stem lesions was slightly less than during the last two field seasons, with 73%, 72% and 66% of crops infested with stem lesions in 1997, 1998 (McLaren and Platford, 1999) and 1999, respectively. The mean incidence in 1999 was 8%. Similar results were reported in 1998 (McLaren and Platford, 1999).

The severity of alternaria pod spot was low, with means of <3% in different crop regions, but prevalence was high in some areas (Table 2). More than 50% of the crops were infested in two of the four crop regions surveyed, with the highest prevalence (97%) in the southwest region (Table 1). In the northwest region, 95% of the crops surveyed for alternaria pod spot were infested. This disease was most prevalent in the western and southwestern part of the province where above normal precipitation was received.

The prevalence of aster yellows in the surveyed crops ranged from 92% in the southwest region to 26% in the eastern/interlake region with a provincial mean of 56%. This increased from a prevalence of 10% in 1998

(McLaren and Platford, 1999). The average disease incidence was 6% in the southwest region and 3% in all other regions.

Foot rot was observed in 2% of the surveyed crops with an average disease incidence of less than 5%.

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ACKNOWLEDGEMENTS: We thank the Manitoba Canola Growers Association for financial support and the Manitoba Crop Insurance Corporation for providing a database of canola fields. The assistance of J.L Lamb in conducting this survey is also gratefully acknowledged as is the technical support of T. Henderson and B. Mitchell.

TABLE 1. Number of canola crops surveyed and disease prevalence in Manitoba in 1999.

Crop Region	No. of crops surveyed	Sclerotinia stem rot		Blackleg				Alternaria pod spot		Aster yellows	
				basal cankers		stem lesions					
		P[1]	DI[2]	P	DI	P	DI	P	Mean %	P	DI
E/I	47	64	10	68	6	70	8	13	1.7	26	3
Central	71	63	8	85	18	75	8	48	1.4	37	3
SW	60	53	6	75	29	73	9	97	2.4	92	6
NW	57	61	7	47	14	42	6	95	1.2	68	3

[1] Mean percent prevalence.
[2] Mean percent disease incidence.

TABLE 2 Distribution of incidence (sclerotinia, blackleg and aster yellows) and severity (alternaria pod spot) classes in 235 crops of *Brassica napus* in Manitoba in 1999.

Incidence/ Severity	PERCENTAGE OF CROPS WITH				
	Sclerotinia stem rot	Blackleg		Alternaria pod spot	Aster yellows
		basal	stem		
0	40	30	35	50	44
1-5%	37	30	39	48	41
6-10%	9	9	9	1	10
11-20%	8	12	9	1	5
21-50%	5	11	8	0	0
>50%	1	8	0	0	0

CROP: Canola

LOCATION: Saskatchewan

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TITLE: SURVEY OF CANOLA DISEASES IN SASKATCHEWAN, 1999

METHODS: A total of 74 fields of *Brassica napus* were surveyed between August 16 and September 1, mostly in the major canola production regions of Saskatchewan including the north-east (26), north-west (8), east-central (22), west-central (4), central (13) and south (1). The fields were surveyed shortly before swathing and when the crop was between growth stages 5.2 and 5.3 (Canola Council of Canada). Disease assessments were made in each field by collecting 20 plants at each of 5 sites separated by at least 20 m and away from the edge of the field. The presence or absence of lesions on each plant was determined to give percent disease incidence for the following diseases: sclerotinia stem rot (*Sclerotinia sclerotiorum*), blackleg (*Leptosphaeria maculans*), aster yellows (AY phytoplasma) and foot rot (*Rhizoctonia*, *Fusarium*). For sclerotinia stem rot, each plant was scored for either a main stem lesion or an upper branch/pod lesion. For blackleg, each plant was scored for either a severe basal stem canker or any other type of blackleg stem lesion. For alternaria pod spot (*Alternaria brassicae*, *A. raphani*), the percent severity of lesions on the pods of each plant was assessed. If alternaria pod spot was present in a field, but at a level estimated to be below 1%, the disease was recorded as a "trace". Similarly, when the other diseases were observed in a field, but not in the sample of 100 plants, the disease was recorded as a "trace". When calculating means, all trace values were counted as 0.1%. The results were combined for each region and mean disease incidence or severity values were determined.

RESULTS AND COMMENTS: Sclerotinia stem rot was observed in 72 of the 74 fields and incidence values ranged from 0 to 51% for main stem lesions and from 0 to 40% for upper branch/pod lesions. Mean incidence was highest in the north-east region, followed closely by the north-west region and lowest in the south region (represented by only one field) (Table 1). The overall incidence values for the province were 13% main stem lesions and 9% upper branch/pod lesions, indicating a yield loss to canola producers of approximately 10% (Morrall et al., 1984). Approximately 60% of total sclerotinia stem rot was a result of main stem lesions, and although the percentage varied among regions, main stem lesions were more common than upper stem/pod lesions. Incidence values were higher in 1999 than in the previous few years (Canola Council of Canada, R.A.A. Morrall, unpublished data). This was likely a result of above normal precipitation promoting sclerotial germination and a prolonged flowering period. About 40% of the fields surveyed in the north-east and east-central regions had been sprayed with a fungicide to control sclerotinia stem rot.

Blackleg was observed in 60 of the 74 fields. Incidence values ranged from 0 to 32% for basal stem cankers and 0 to 76% for lesions occurring elsewhere on the stem. The highest values occurred in fields that had received hail damage during the growing season. Blackleg incidence values were highest in the central and east-central regions and lowest in the south region (Table 1). The overall means for the province were 3% basal stem cankers and 8% lesions found elsewhere on the stem. Approximately 73% of blackleg lesions were not scored as basal stem cankers, indicating limited impact on seed yield and quality.

Aster yellows was observed in 63 of the 74 fields. Overall mean incidence for the province was 1% (Table 1). Incidence ranged from 0 to 6% with the highest in the east-central region. The incidence observed in 1999 was unusually high and likely a result of prolonged and rank crop growth, due to cool moist weather conditions, and the presence of an infected leaf hopper population.

Foot rot was observed in 31 of the 74 fields. Disease incidence ranged from 0 to 13% with the highest in the central region (Table 1). The overall mean for the province was 0.9%.

Alternaria pod spot was observed in 70 of the 74 fields but mostly at trace levels. The highest severity of 7.5% was reported in a field in the west-central region. The survey was conducted before swathing so severity may have been lower than at harvest when pod spot development typically increases.

There were no reports of brown girdling root rot or staghead in any of the fields surveyed.

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Table 1. Canola diseases in Saskatchewan in 1999.

Region[1]	No. of fields	% Disease Incidence						% Disease Severity
		Sclerotinia[2]		Blackleg[3]		Aster Yellows	Foot Rot	Pod Spot
		Main	Upper	Canker	Other			
North-east	26	16	15	3	3	0.6	0.3	0.5
North-west	8	22	6	4	3	0.4	0.9	0.3
East-central	22	10	4	2	13	2.0	1.0	0.2
West-central	4	4	2	3	5	0.1	1.3	2.3
Central	13	12	8	5	14	0.6	1.7	0.2
South	1	t[4]	t	0	4	t	0	t
Overall Mean		13	9	3	8	1	0.9	0.4

[1] The regions surveyed included the following cities and towns:

North-east = Tisdale, Nipawin, Melfort, Prince Albert
North-west = Lashburn, Spiritwood
East-central = Kuroki, Ituna, Raymore, Kelliher
West-central = Biggar
Central = Watrous, Allan, Asquith, Delisle
South = Regina

[2] Sclerotinia stem rot lesions were scored as either a main stem lesion or as an upper branch/pod lesion.

[3] Blackleg lesions were scored as either a severe basal stem canker or as any other type of stem lesion.

[4] t = trace amounts of disease (< 1%) or were not found in the 100 plant sample but present in the field; in calculating means, trace values are 0.1%.

CROP: Chickpea (*Cicer arietinum* L.)

LOCATION: Southern Alberta

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TITLE: SURVEY FOR ASCOCHYTA BLIGHT AND ROOT ROT DISEASES OF CHICKPEA IN SOUTHERN ALBERTA IN 1999

METHODS: Eighteen commercial chickpea fields (Table 1) were sampled in the first week of September for root rot and ascochyta blight. Ten plants were dug in small fields (0.05 ha) and 20 plants were dug in large fields. The plants were collected at five equally spaced sites along the arms of a "W" sampling pattern in each field. Roots were washed and assessed for root rot severity. The leaves were assessed for ascochyta blight severity.

Root rot severity was estimated visually on the samples by using the following scale: 0 = no root rot, 1 = 1-10% root discoloration, 2 = 11-25% root discoloration, 3 = 26-50% root discoloration, and 4 = > 51% root discoloration. Basal stem and root pieces from each field were surface sterilized in 1% NaOCl for 2 minutes, rinsed three times in sterile distilled water and plated onto acidified potato dextrose agar (PDA) to determine the types of microorganisms present (Table 2). Foliar disease was estimated visually using the 0-9 scale developed by Xue and Burnett (1).

RESULTS AND COMMENTS: Out of 18 fields (867 ha), 11 showed very slight root rot (mean = 0.6). These results are similar to those obtained in a survey conducted in west-central Saskatchewan in 1998 (2). No root rot disease was found in the fields surveyed at Nobleford, Taber or Wrentham but several microorganisms were isolated from root samples collected from Strathmore and Carmangay (Table 1, 2). *Fusarium* spp. were the most prevalent microorganisms isolated from infected roots, followed by *Gliocladium* spp., *Alternaria* spp. and *Botrytis* spp. *Pythium* spp., *Sclerotinia sclerotiorum*, *Penicillium* spp. and *Aspergillus* spp. comprised a minor portion of the microorganisms isolated. Nematodes and bacteria were also commonly isolated from the samples. The microorganisms isolated from root samples collected from fields near Strathmore were more numerous and varied than those found near Carmangay. The mean ascochyta blight severity was 2.6, which indicates slight infection on the 0-9 scale.

ACKNOWLEDGEMENTS: The authors wish to thank J. Kubik (Kubik Seed Farms Ltd.) and E. Hubka (Hubka Family Farms Ltd.) for their co-operation and assistance in providing lists of other chickpea growers.

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Table 1. Severity of root rot and ascochyta blight on chickpea from 18 fields in southern Alberta in 1999.

Location	No. fields surveyed	Chickpea type	Disease severity	
			Root rot (0-4)	Ascochyta blight (0-9)
Carmangay	7	Kabuli	0.2 (0-0.7)	2.0 (0.6-4.1)[a]
Carmangay	1	Desi	0	3
Nobleford	1	Kabuli	0	5.1
Strathmore	3	Kabuli	1.5 (1.2-1.6)	2.1(2.0-2.2)
Strathmore	1	Desi	1.0	1.5
Taber	3	Kabuli	0	3.0
Wrentham	2	Kabuli	0	3.6 (3.2-4.0)

[a] Number within brackets are ranges of disease severity.

Table 2. Microorganisms isolated from roots of chickpea sampled from 10 fields in southern Alberta in 1999.

% Microorganisms isolated from root samples*	Field Location									
	Strathmore				Carmangay					
Fusarium spp.	94	84	98	90	30	10	20	30	30	0
Bacteria	24	40	58	63	0	0	0	10	0	0
Alternaria spp.	20	32	40	35	0	0	0	0	0	0
Gliocladium spp.	20	10	18	25	20	0	10	30	0	0
Nematodes	16	26	32	13	0	0	0	10	0	0
Botrytis spp.	18	2	6	5	0	30	10	0	20	0
Penicillium spp.	6	24	16	35	0	0	0	0	0	0
Trichoderma spp.	6	31	26	5	0	0	0	0	0	0
Rhizopus spp.	4	6	8	3	10	0	10	20	10	10
Pythium spp.	14	10	16	0	0	10	0	10	0	0
Sclerotinia	0	2	0	5	0	0	0	0	0	0
Unknown	0	2	0	0	0	0	0	0	0	0
Aspergillus spp.	0	0	2	0	0	0	0	0	0	0

* The average percentage of roots from each field containing each microorganism (five sampling sites/field and 10 roots/sampling site).

CROP: Chickpea (*Cicer arietinum*)

LOCATION: Saskatchewan

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TITLE: SASKATCHEWAN CHICKPEA DISEASE SURVEY - 1999

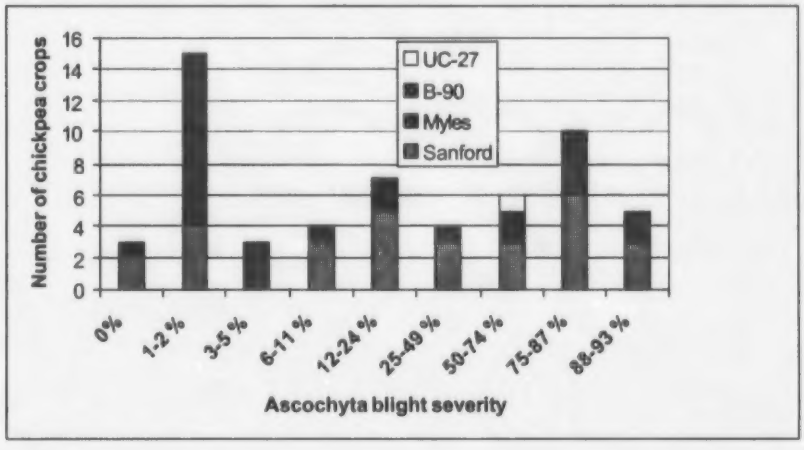
METHODS: A total of 57 chickpea fields were surveyed in Saskatchewan from July 13 to July 30, 1999. The survey route covered a triangle between Saskatoon, Regina and Swift Current (Fig. 1). Two thirds of the crops were at mid flower, and other fields were at 10-20% flowering or in the pod filling stage. The desi-type cultivar Myles was grown in 25 of the fields, while 29, 2 and 1 were planted to the kabuli-type cultivars Sanford, B-90 and UC-27, respectively. Ascochyta blight (*Ascochyta rabiei)* severity was assessed using the 0 -11 Horsfall-Barratt scale on ten plants at five randomly chosen sites in each field. The average of the five ratings was converted to percent infected leaf and stem area. In some fields, plants were sampled for pathogen identification as previously described (1). As an extension service, most observations were posted within a few days on the Pulse Disease Website at:
http://paridss.usask.ca/specialcrop/pulse_diseases.

Figure 1. Saskatchewan map: Asterisks represent approximate location of chickpea fields surveyed for ascochyta blight, July 13-30, 1999.

RESULTS AND CONCLUSIONS: As it has been shown that the cultivars Sanford, Myles and B-90 are fairly resistant to *A. rabiei* from emergence to early flowering, the survey was conducted when the crops were becoming more susceptible. Precipitation from May to September at weather stations across Saskatchewan was 13 -116 % higher in 1999 than the long-term normals, and growing degree days were 84-95% of the normal. The cool, wet weather conditions favored spread and development of ascochyta blight, and also

prolonged flowering and maturity of chickpea. As a result, ascochyta blight was present in all surveyed fields except three. The incidence and severity of ascochyta blight was higher in chickpea crops in the Central region compared to the region south of Swift Current and Regina.
Swift Current had only 13% more rainfall than normal and 95% of the growing degree days. The worst problems were encountered around Rosetown, Elrose, Davidson, Kyle and Lucky Lake (S.W. and S. of Saskatoon). Fields planted to Sanford and Myles were divided into ten disease severity groups as shown in Fig. 2. While the number of fields planted to cv. Sanford was equally represented in all severity groups, more fields with low ascochyta severity (less than 11%) were planted to cv. Myles compared to fields planted to Sanford (Fig. 2). The two B-90 chickpea crops had 0% and 12-24% ascochyta infection, and UC-27, which is highly susceptible to ascochyta, had 50-75% infection. Compared to 1998, there was also a noticeable increase in the incidence of sclerotinia stem rot and botrytis blight (data not shown).

Figure 2. Distribution of 57 chickpea fields planted to cultivar UC-27, B-90, Myles or Sanford according to ascochyta blight severity.



A number of factors contributed to the severity of ascochyta blight that occurred in many fields. These included cool, wet weather favorable for pathogen spread and infection, build- up of inoculum in areas with a relatively long record of chickpea production, planting of infected seed, formation of the sexual stage and dispersal of wind-borne ascospores (2), and possibly development of new, and more virulent strains of *A. rabiei*. In some fields, the result of seed-borne infection was apparent as evenly distributed patches of dying plants.

ACKNOWLEDGMENTS: Reports to the Pulse Crop Diseases web site were submitted by staff with Saskatchewan Agriculture and Food Grant Holzgang, Grant McLean, Ray McVicar, Elaine Meachem, Garry Noble and Penny Pearse. Financial support from the Agri-Food Innovation Fund is gratefully appreciated.

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CROP: Coneflower [*Echinacea angustifolia* DC, *E. purpurea* (L.) Moench.]

LOCATION: Central and southern Alberta

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TITLE: SURVEY OF ASTER YELLOWS OF ECHINACEA IN ALBERTA IN 1999

INTRODUCTION AND METHODS: Aster yellows of *Echinacea angustifolia* (*Ea*) and *E. purpurea* (*Ep*) has been observed in Alberta since 1995 (1, 2, 3, 4). To continue monitoring the disease, a survey similar to the one conducted in 1998 was repeated in 1999. Eight echinacea plantings were surveyed between early June and late September, and the numbers of healthy and diseased plants were recorded in five, 5 x 5 m^2 sample areas (four corners and the centre) at each location. At an experimental site at Brooks, all plants from 40 (1-yr-old *Ea*), 72 (1-yr-old *Ep*) and 28 (2-yr-old *Ea*) plots, respectively, were checked for the disease. Disease incidence (DI) was calculated by dividing the number of diseased plants by the total number of plants surveyed and calculating a percentage.

RESULTS AND DISCUSSION: Aster yellows of *Echinacea* spp. was found in all fields surveyed (Table 1). Due to slow establishment of *Ea*, leaf reddening and yellowing symptoms were not usually observed on 1-year-old crops until the end of the growing season. Phyllody appeared only on 2-year-old plants. Disease incidence varied with location, age and species of the crop. For first-year *Ea* crops, the highest DI occurred at Clive and ranged from 2.0 to 8.0% with a mean of 3.4%. A 17% DI occurred in second- year *Ea* plots (Table 1). The 0.9% DI in a field at Edmonton was an underestimate, since diseased plants were eliminated from the field before the data were taken. Alberta Agriculture, Food and Rural Development recently published a fact sheet which enables growers to identify diseases of echinacea (2). Some growers have realized the importance of aster yellows infection and have begun to rogue infected plants from the field before infection is widespread.

The average DI of aster yellows on 1-year-old *Ep* was 21.7%, much higher than the DI observed on *Ea* crops of the same age. At Brooks, diseased plants were not removed from 1-yr-old *Ep* plots in 1998. Disease incidence in these plots had increased by 70% over 1998 (1), so these plots were plowed down in June 1999 to prevent the disease from spreading to newly established echinacea plots.

In conclusion, aster yellows was found in all echinacea crops surveyed in Alberta. Periodic monitoring for this disease is recommended for both species of echinacea. Elimination of diseased plants should result in a lower DI in the following year. However, other control measures need to be developed to reduce crop losses caused by aster yellows.

ACKNOWLEDGMENTS: Financial support was provided through a grant from the Alberta Agricultural Research Institute, Edmonton.

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Table 1. Incidence of aster yellows in crops of *Echinacea* spp. at six locations in Alberta, 1999

Location	*Echinacea* species[x]	Crop age (yr.)	No. plants surveyed	Disease incidence (%)	
				Range	Mean
Edmonton	*Ea*	2	1500	0.3 - 2.0	0.9
Brooks-1	*Ea*	1	3200	0.6 - 5.3	1.4
Blackfalds	*Ea*	1	500	1.0 - 4.0	2.2
Onoway	*Ea*	1	500	0 - 7.0	2.8
Clive	*Ea*	1	500	2.0 - 8.0	3.4
Lacombe	*Ea*	2	2961	1.4 - 11.4	4.4
Brooks-2	*Ea*	2	1539	12.5 - 27.5	17
Brooks-3	*Ep*	1	5760	7.5 - 36.3	21.7

[x] *Ea* = *Echinacea angustifolia*; *Ep* = *E. purpurea*

CROP: Coneflower (*Echinacea angustifolia* DC.)

LOCATION: Central and eastern Alberta

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TITLE: THE OCCURRENCE OF DAMPING-OFF AND ROOT ROT OF ECHINACEA IN GREENHOUSES OF ALBERTA IN 1999

INTRODUCTION AND METHODS: More than two million seedlings of *Echinacea angustifolia* (*Ea*) were propagated under greenhouse conditions in Alberta in 1999. Damping-off and root rot caused by soil-borne pathogens was observed in several greenhouses (1, 3). However, systematic surveys of seedling diseases on this crop have not been conducted in Alberta. In 1999, echinacea seedlings in five greenhouses were surveyed for damping-off and root rot diseases from mid- to late April. Seeds had been sown into flat trays or plug trays filled with soilless mix. The number of healthy and diseased seedlings was recorded in 10-20 trays which were selected from the four corners and the central area of each greenhouse. Disease incidence (DI) in each tray was calculated by dividing the number of diseased plants by the total number of plants and calculating a percentage. To determine the microorganisms involved in the root rot, infected seedlings were returned to the laboratory and the roots were cut into 3-5 mm pieces, which were sterilized in 1% NaOCl for 2 minutes. Samples were then rinsed four times with sterile distilled water and transferred onto petri plates containing potato dextrose agar (PDA). The plates were incubated on a laboratory bench for 7 days. Isolated microorganisms were transferred onto PDA slants for further identification.

RESULTS AND DISCUSSION: Damping-off and root rot diseases were found in all greenhouses surveyed. Disease incidence varied with greenhouses (Table 1). The highest DI ranged from 3.1-35.2% with a mean of 16.3%. The second highest DI was 8%. Diseased plants either showed damping-off or root rot, with leaves turning yellow, purple or red. The basal portion of the stem was brown to black and infected seedlings were easily pulled from the medium. Fungi belonging to five genera were isolated from infected roots, indicating that the microflora in the root systems was simple (Table 2). *Fusarium* spp. were the predominant microorganisms isolated from all greenhouses, followed by *Penicillium* spp., *Alternaria* spp., *Rhizopus* spp., *Pythium* spp. and bacteria. *Fusarium oxysporum* was isolated from roots which showed discolouration of the vascular bundle. *Alternaria* spp. were isolated from 40.9% of the root samples from greenhouse No. 2. These isolates also produced round to elongate, dark brown to black leaf lesions of various sizes. Previously, *Alternaria* spp. have been isolated as common seedborne pathogens which can also infect roots of *Ea* (2). Bacteria were occasionally isolated from diseased roots, but their pathogenicity has not been verified. *Rhizoctonia solani* was not found in the diseased plants surveyed.

The number of seeds per tray was not recorded at seeding time, so the rate of pre-emergence damping-off could not be determined. Seed germination rates varied with seed sources and automatic seeders may have missed some of the plugs.

In greenhouse No. 3, seeds were sown on flat trays and covered with approximately 1-2 mm of soilless mix after seeding. Therefore, once infection occurred in a tray the pathogen spread very rapidly and easily. Watering practices often exposed roots of germinated seeds to the air, which left them subject to drought and pathogen infection. Infection either caused the root tip to turn brown or caused a constriction in the middle part of the root. Cotyledons often could not emerge from the seed coat when seeds were infected or when

germinating seeds were exposed to the air. Weeds were also observed in the trays indicating that the soilless mix may not have been sterile.

In conclusion, *Fusarium* spp. were the most frequently isolated pathogens from diseased seedlings of echinacea in Alberta. Sources of primary inoculum need to be identified and control measures for these pathogens need to be developed to maximize the net profit of this crop to growers.

ACKNOWLEDGMENTS: T. Schick assisted in the isolation of microorganisms. Financial support was provided through a grant from the Alberta Agricultural Research Institute, Edmonton.

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Table 1. Incidence of damping-off and root rot in trays of *Echinacea angustifolia* in greenhouses at five locations in Alberta, 1999

Greenhouse number	Location	No. trays surveyed	No. seedlings surveyed	Disease incidence (%)	
				Range	Mean
1	Morinville	20	3530	0 - 6.1	3.4
2	Morinville	20	1310	0 - 8.3	2.3
3	Hayter	10	2502	4.0 - 16.9	8
4	Morinville	20	4160	3.1 - 35.2	16.3
5	Sherwood Park	50	4639	0 - 26.6	2.1

Table 2. Percent recovery of microorganisms from infected roots of *Echinacea angustifolia* obtained from three locations in Alberta in 1999

Greenhouse number	No. roots sampled	% recovery from roots					
		Fusarium spp.	*Penicillium* spp.	*Alternaria* spp.	*Rhizopus* spp.	*Pythium* spp.	Bacteria
5	64	98.4	42.2	0	14.1	7.8	3.1
2	22	95.5	31.8	40.9	0	4.5	0
4	190	84.3	53	10.4	1	12.7	0

CROP: Flax

LOCATION: Manitoba

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TITLE: DISEASES OF FLAX IN MANITOBA AND EASTERN SASKATCHEWAN IN 1999

METHODS: A total of 61 flax crops in southern Manitoba and 41 in central and eastern Saskatchewan were surveyed in 1999. Seven crops were surveyed in July, 65 during the third week of August, 16 during the first week of September, and 14 were surveyed during the third week of September. Solin flax with low linolenic acid and yellow seed colour was distinguished in five crops of those surveyed in August and September (5%), and linseed constituted 95%. Crops surveyed were selected at random along preplanned routes in the major areas of flax production. Each crop was sampled by two persons walking 100 m in opposite directions in the field following an "M" pattern. Diseases were identified by symptoms and the incidence and severity of each disease were recorded. Stand and vigour were rated on a scale of 1 to 5 (I = very good, and 5 = very poor).

In addition, 59 samples of flax plants were submitted for analysis to the Manitoba Agriculture Crop Diagnostic Centre by agricultural representatives and growers.

RESULTS AND COMMENTS: Eighty five percent of the flax crops surveyed in 1999 were rated very good for stand establishment, and 66% had very good vigour. Only 16% of the crops surveyed were seeded late and were expected to be late for maturity and harvesting. Growing conditions were generally good except for abnormally wet conditions at seeding time in southwestern Manitoba and southeastern Saskatchewan, which resulted in late seeding in several fields.

Pasmo (*Septoria linicola*) was observed in 92% of the crops surveyed (Table 1). The prevalence and severity of pasmo in 1999 were higher than in the two previous years (1, 2), due perhaps to the relatively wet weather throughout the growing season and the high humidity in crops with a dense canopy. In the infested crops, pasmo incidence ranged from 1% to 100% infected plants, and severity from 1% to >50% stem and leaf area affected. Twenty four percent of the crops had >60% plants severely infected with pasmo.

Heavily lodged flax was observed in 50% of crops, and traces to 80% of the plant area affected by *Alternaria* and other saprophytic fungi were observed in lodged crops. Frequent visits to some flax fields in southern Manitoba towards the end of the season revealed higher levels of pasmo and alternaria infections than those observed in mid August. Most of the severely affected crops were near Regina, Outlook, Saskatoon, Melfort, and Yorkton in Saskatchewan; and near Killarney, Neepawa, Portage la Prairie, Steinbach, and south central areas in Manitoba.

Flax stems infected by *Sclerotinia sclerotiorum* were observed in Manitoba and Saskatchewan in heavily lodged flax crops. Typical symptoms were white bleached and shredded sections of the stems extending from the soil level up to two-thirds the stem height, due perhaps to mycelial infection from the soil. Mid-stem infections and bleached sections high on the stems were also observed, probably from ascospore infections on different sections of the stem. The sclerotinia infections seem to have started on senescent tissue in heavily lodged flax.

Root infections and fusarium wilt (*Fusarium oxysporum f.sp. lini*) were observed in 93% of flax crops in 1999 in comparison to 86% of crops in 1997 when this disease was thoroughly surveyed (2). Fusarium wilt severity ranged from trace to10%, except in one severely infested field near Treherne in Manitoba.

Powdery mildew (*Oidium lini*) was observed again in 1999 in 67% of the crops surveyed in Manitoba and Saskatchewan with a severity range from trace to 50% leaf area affected. The incidence and severity of this disease have increased sharply since it was first reported in western Canada (2). Frequent visits to some flax fields in southern Manitoba towards the end of the season revealed higher levels of powdery mildew than those observed in mid August. Most of the flax crops affected by powdery mildew were near Regina, Saskatoon, Melfort, and Yorkton in Saskatchewan, and near Killarney, Minnedosa, Portage la Prairie, Steinbach, and south central areas in Manitoba.

Traces to 5% plants affected were observed for aster yellows (phytoplasma) in 45% of the flax crops in 1999. The incidence and severity of aster yellows in 1999 were higher than any level recorded on flax in the last 10 years due, perhaps, to warm weather early in the growing season which resulted in early migration of leaf hoppers from the south . Rust (*Melampsora lini*) was not observed in any of the 102 crops surveyed, nor in the rust-differential flax nurseries planted at Morden and at Portage la Prairie.

Of the 59 flax samples submitted to the Manitoba Agriculture Crop Diagnostic Centre, three were affected by pasmo (*Septoria linicola*), 12 were affected by fusarium wilt/root rot (*Fusarium oxysporum f.sp. lini* and other *Fusarium* spp.), five were affected by aster yellows phytoplasma, and two were affected by *Alternaria* spp. In addition to diseases, 31 samples were affected by herbicide injury, and six were affected by various environmental factors.

ACKNOWLEDGEMENTS: The assistance of L. J. Wiebe in conducting this survey is gratefully acknowledged.

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Table 1. Incidence and severity of fusarium wilt, pasmo, and powdery mildew in 102 crops of flax in southern Manitoba and east central Saskatchewan in 1999.

Crops affected by fusarium wilt				Crops affected by pasmo				Crops affected by powdery mildew			
Crops		Disease		Crops		Disease		Crops		Disease	
No.	%	Incid* (%)	Sever.** (%)	No.	%	Incid.* (%)	Sever.** (%)	No.	%	Incid.* (%)	Sever.** (%)
7	7	0	0	8	8	0	0	35	34	0	0
62	60	1 - 5	1 - 5	26	25	1 - 10	1 - 5	28	27	1 - 10	1 - 5
18	18	5 - 20	5 - 10	18	18	10 - 30	5 - 10	22	22	10 - 30	5 - 10
9	9	20 - 40	10 - 20	25	24	30 - 60	10 - 20	12	12	30 - 60	10 - 20
6	6	> 40	10 - 40	25	24	> 60	10 - 50	5	5	> 60	10 - 50

* Incidence = Percentage of infected plants in each field.

** Severity = Percentage of roots affected by fusarium wilt, stems affected by pasmo, and leaves affected by powdery mildew.

CROP: Hemp

LOCATION: Prince Edward Island

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TITLE: **REPORT OF WHITE MOLD (*SCLEROTINIA SCLEROTIORUM*) ON HEMP IN PRINCE EDWARD ISLAND, 1998-1999.**

METHODS: Since 1998, hemp (*Cannabis sativa* L.) has been grown, under a special permit, on a limited acreage at two locations on Prince Edward Island (PEI). Commercial fields were inspected for white mold infection in 1998 and 1999. Diagnosis was based on symptoms on plants and cultural morphology of the fungus isolated from plant samples on potato dextrose agar (PDA).

RESULTS AND COMMENTS: White mold was observed on hemp at both locations in 1998 and 1999. Symptoms included soft watery lesions with fluffy white mycelial growth on stems and leaves. As the stem lesions dried out, the infected areas turned bleached to tan colour. Sclerotia developed on and in the decaying and dried stems. The fungus, *Sclerotinia sclerotiorum*, was isolated from infected samples on PDA and formed typical sclerotia.

This is the first report of white mold on hemp on PEI. Because of large scale commercial production of potato on the Island, and the occurrence of white mold on potato since 1924 (1), it is likely that the pathogen is present in soils of many commercial fields on PEI. To avoid problems in hemp and in susceptible rotation crops, precautions should be taken to ensure proper rotation and cropping sequences as hemp production increases on PEI.

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CROP: Lentil

LOCATION: Saskatchewan

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TITLE: DISEASES OF LENTIL IN SASKATCHEWAN 1999

METHODS: Randomly selected lentil fields were surveyed in Saskatchewan from pre-flower to maturity to assess the severity of anthracnose (*Colletotrichum truncatum*), ascochyta blight (*Ascochyta lentis*), gray mold (*Botrytis cinerea*), stem rot (*Sclerotinia sclerotiorum*), root rot and seedling blight. The severity of each disease was assessed either using percent infected leaf and stem area or a notation of: No disease, trace, slight, moderate, and severe. The fields were categorized in five groups as follows: No disease = 0%, trace = 1-5% infected stem and leaf area, slight = 6-24%, moderate = 25-49%, and severe = >50%. A total of 185 fields were surveyed, but some fields were assessed up to four times in the growing season resulting in 527 single observations. The percent fields in which ascochyta, anthracnose, sclerotinia, botrytis and root rot were identified at each of five growth stages was calculated (Fig. 1). For each disease, the percent fields in the five disease severity categories was also calculated (Fig. 2). One source of observations was reports submitted by extension agrologists with Saskatchewan Agriculture and Food, which were posted on a Pulse Crop Diseases web site (1). The purpose of these reports was to show when and where ascochyta blight and anthracnose occurred early in the season in time for fungicide application.

RESULTS AND COMMENTS: Ascochyta blight was the most common disease affecting 40-70% of the crops from pre-flower to late flower, but was identified in only 20% of the fields at maturity (Fig. 1). Anthracnose was present in 20-30% of the fields throughout the season. Sclerotinia and botrytis were found in very few fields up to mid flower, but affected 25-30% of the fields at maturity, while root rot or seedling blight were identified in 10-15% of the fields at pre-flower, and again at late flower and maturity (Fig. 1). Fig. 2 shows the severity of the five diseases in 1999 averaged over the season. Half of the lentil fields were not affected by ascochyta, while the other disease were not found in 70-85% of the fields. Between 5 and 25% of the fields had traces of one or more of the diseases, 5-20% of the fields were slightly affected often with less than 25% infected leaf and stem area, while 1-5% had moderate or severe disease levels i.e., more than 25% leaf and stem area affected.

The incidence of anthracnose was lower in 1999 than 1998, when half the fields with anthracnose were severely affected (2). This was likely due to periods of higher temperatures in the 1998 growing season, which favour anthracnose, in contrast to the cooler conditions in 1999. It might also partly be due to more timely fungicide applications in 1999. Only 4% of lentil crops in 1998 were slightly or moderately affected by ascochyta blight, in contrast to 23% in 1999, probably due to cool, wet weather in July and August. This also led to unusually high incidence and severity of sclerotinia stem rot, grey mold and root rot, commonly found only at trace levels in lentil.

Since inoculum of the anthracnose pathogen is dispersed by wind it is useful for lentil growers to know whether the disease is present in a production area. In 1998 and 1999, fields with slight, moderate or severe anthracnose or with more than 6% infected leaf and stem area were observed in the following crop districts and rural municipalities (RM) of Saskatchewan: 2B (RM 128,130,159,160), 3A-S (9), 3B-N (20), 5B (308), 6A (252, 281, 282, 343), 6B (253, 285, 316), 7A (258, 287, 288, 290, 317), 9A (437), and 9B (439). Fields with a

trace of anthracnose or less than 6% infection were found in the following crop districts and RMs: 2B (RM 129, 161), 3A-N (133), 3B-N (135, 136, 257), 6A (189, 279), 6B (254, 315), and 8B (401).
A map of rural municipalities in Saskatchewan can be found on the Pulse Crop Diseases web site (1).

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Figure 1. Prevalence of five diseases in 185 lentil fields surveyed at different growth stages in Saskatchewan, 1999.

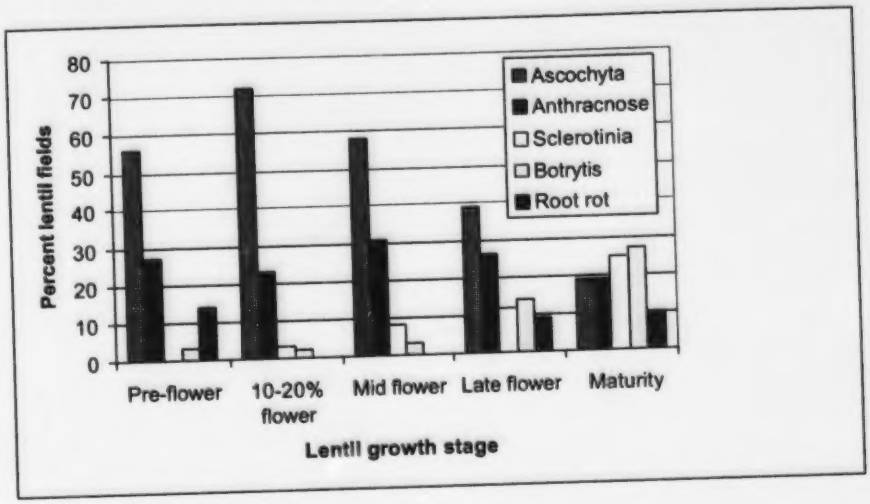
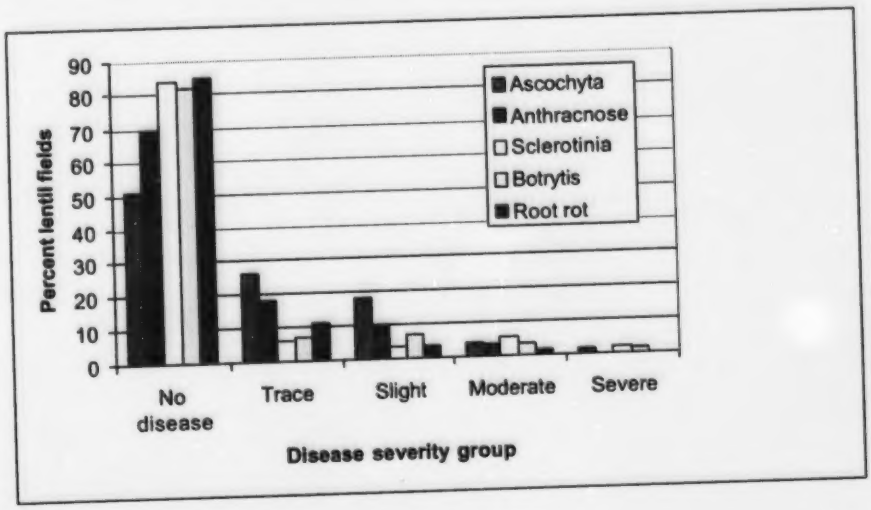


Figure 2. Incidence and severity of five diseases in 185 lentil fields surveyed in Saskatchewan, 1999.



CROP: Lentil

LOCATION: Southern Alberta

NAME AND AGENCY:
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TITLE: SURVEY OF DISEASES OF LENTIL IN SOUTHERN ALBERTA IN 1999

METHODS: Eleven dryland crops of lentil were surveyed during the early growing season (July 8) for damping-off, and during the late growing season (August 27) for gray mold caused by *Botrytis cinerea*. Lentil fields were located in the area east of New Dayton-Warner-Milk River, Alberta. Each crop was surveyed by inspecting ten sites in a U-shaped pattern, with approximately 20 m between sites. For the damping-off survey, each site consisted of a 1 m length of row, which was equivalent to 20 seeds (90 kg/ha seeding rate at 15 cm row spacing). For the gray mold survey, each site consisted of 20 plants in a 1 m length of row. The percentage of non-emerged seedlings in the first survey and percentage of plants with gray mold in the second survey were calculated for each crop by averaging the results from the ten sites. The level of damping-off and gray mold in each crop was categorized according to the following scale: (1) none (0% of plants infected), (2) trace (<1%), (3) light (1-10%), (4) moderate (11-25%), (5) high (26-50%), (6) very high (>50%).

Samples of diseased seeds, seedlings and plants were collected from the surveyed crops, surface sterilized for 90 seconds in 70% ethanol, plated on potato dextrose agar and incubated at 20 C under light for 2 weeks, to verify the causal agent.

RESULTS: During the first survey, damping-off was found in all of the 11 crops inspected. Isolation from non-emerged seeds and wilted seedlings showed that 88% were infected with *B. cinerea*. Disease incidence ranged from 6 to 39% of seedlings infected. The frequency of crops with light, moderate and high incidence of damping-off was 46%, 36% and 18%, respectively. The disease was distributed throughout the southern Alberta lentil production area.

During the second survey, gray mold was found in all of the 11 crops inspected. Results of isolations from diseased plants showed that 100% were infected with *B. cinerea*. Disease incidence ranged from 3 to 62% of plants infected. The frequency of crops with moderate, high and very high incidence of gray mold was 27%, 9% and 18%, respectively. The disease was distributed throughout the entire lentil production area of southern Alberta.

DISCUSSION: Information collected from producers during the survey indicated that damping-off may be a serious problem when using seed harvested from local crops during the previous growing season. For the two crops with high incidence of damping-off, the producers confirmed the use of seed from local sources. The same producers had other crops grown from seed from a non-local source, and these crops had a light incidence of damping-off. This supports the finding of Carter and Morrall (1997) that seed-borne inoculum is an important factor in damping-off of lentil due to *B. cinerea*.

Results of the 1999 survey indicate that gray mold was widespread and severe on lentil in southern Alberta. This disease was found on lentil in Alberta in 1995 (Huang and Erickson, 1996), 1997 (Huang and Erickson, 1998) and 1998 (Huang and Erickson, 1999); in Saskatchewan in 1994 (Morrall et al, 1995); and on dry bean in southern Alberta in 1993 (Huang and Erickson, 1994) and 1994 (Huang et al, 1995).

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CROP: Lentil, pea, chickpea

LOCATION: Saskatchewan

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TITLE: SEED-BORNE PATHOGENS OF LENTIL, PEA AND CHICKPEA IN SASKATCHEWAN IN 1999.

METHODS: The results of agar plate tests conducted by three Saskatchewan companies on seed samples from the 1999 crop were summarized. The tests were conducted mainly to detect the pathogens causing ascochyta blight (*Didymella* [*Ascochyta*] *lentis*), anthracnose (*Colletotrichum truncatum*) and grey mould (*Botrytis cinerea*) of lentil, ascochyta blights (*Mycosphaerella* [*A.*] *pinodes* and *A. pisi*) and botrytis blight (*B. cinerea*) of pea, and ascochyta blight (*A. rabiei*) and botrytis blight (*B. cinerea*) of chickpea. Not all samples were tested for *Colletotrichum* and *Botrytis* but all were tested for their respective ascochyta blight pathogens. Figures for *Ascochyta* spp. and *B. cinerea* were classified according to crop districts [CD] of Saskatchewan (5). It was unknown which of the samples came from crops that had been treated with registered fungicides. Bravo (a.i. chlorothalonil) is widely used as a foliar protectant on lentil and chickpea. Crown (a.i. thiabendazole + carbathiin) is often used as a seed treatment on lentil and Apron (a.i. metalaxyl) is widely used as a seed treatment on kabuli chickpea.

RESULTS AND COMMENTS: In most areas of Saskatchewan the growing season was marked by frequent interruptions to seeding by rainfall and above-normal precipitation and below normal temperatures until mid-August. Consequently, vegetative growth was excessive, maturity of chickpea and lentil was delayed and frost damage occurred on some of these crops in mid-September. However, pea yields were exceptionally high.

By mid-December over 1000 lentil, 400 pea and 700 chickpea seed samples had been tested by the three companies. About 65% of the chickpea samples were kabuli chickpea. The major increase in lentil and chickpea samples over 1998 (3) reflects concern among growers about high levels of seed-borne pathogens and other factors affecting seed quality caused by the wet season. However, for chickpea it also reflects a large increase in acreage.

Levels of seed-borne *Ascochyta* spp. varied among crop districts (Table 1), but were not necessarily highest in areas which received the highest total rainfall in the growing season. Overall, the maximum recorded values were 29.75%, 31.5% and 15.25% for lentil, pea and chickpea, respectively. In corresponding order, the percentages of samples in which no infection was detected were 17, 17 and 54. The overall mean levels of seed-borne *Ascochyta* spp. were more than twice as high, and the percentages of samples in which no infection was detected were substantially lower than in 1998 and 1997 (4,5). The higher prevalence and incidence of *Ascochyta* in chickpea seed samples was in spite of general use of the same cultivars as in 1998, which were considered to have substantial resistance to *A. rabiei*.

Based on a survey (1) and observations by the senior author, ascochyta blights were the major diseases of lentil and chickpea in Saskatchewan in 1999. On pea, ascochyta blight was not severe until late in crop development and did not cause high yield losses; however, symptoms were very evident on the pods and this is consistent with the high seed infection levels observed in many CDs (Table 1).

Botrytis was detected in 31% of lentil samples tested, 35% of pea samples and 50% of chickpea samples. The corresponding percentages in 1998 were 27, 15 and 20 (3). Mean infection levels were fairly low in all three crops (Table 1), but higher than in 1998. The highest levels of infection were 11.0% for lentil, 10.5% for pea and 13.5% for chickpea. Observations and reports received by the senior author showed that, because of the cool wet growing season, failure to mature and *Botrytis* were major problems in chickpea production in 1999. The areas worst affected were outside of the area of optimum adaptation of the crop and this is reflected in the seed infection data (Table 1). Chickpea grows best in the S.W. of Saskatchewan, (i.e. CDs 3A-S, 3B-N, 3B-S, 4A, 4B, and 7A).

Colletotrichum truncatum, which is not a highly seed-borne pathogen, was detected in 84 (9.8%) of the lentil samples tested and from CD 2A, 2B, 3A-N, 3B-N, 3B-S, 4B, 5A, 5B, 6A, 6B, 7A, 7B and 8B. The highest level of seed infection detected was 7.0%. Although anthracnose was less important in lentil production in 1999 than 1998 (1,2,3), all indications are that the disease has continued to spread into most lentil producing areas.

In addition to the diseases and pathogens discussed above, *Sclerotinia sclerotiorum* was more commonly isolated from lentil, pea and chickpea seed samples than in any recent year (data not shown). Furthermore, sclerotial contamination of seed samples, especially lentil, was more common than usual.
Often lentil and chickpea seed with a high percent infection with *Botrytis* also contained *Sclerotinia*, but at a lower level. The prevalence of *Sclerotinia* in seed of these crops is consistent with survey data (1) as well as reports received by the senior author during the summer, and again reflects the cool wet weather.

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Table 1. Number of pulse crop seed samples tested from August to mid-December, 1999 by three commercial companies, and mean percent infection with *Ascochyta* (ASC) and *Botrytis* (BOT) in relation to Saskatchewan crop districts (CD)[1].

CD	LENTIL			PEA			CHICKPEA		
	# samples tested[2]	Mean % ASC	Mean % BOT	# samples tested	Mean % ASC	Mean % BOT	# samples tested	Mean % ASC	Mean % BOT
0.04	5 / 5	0.3	1	10 / 9	1.6	0.1	21 / 16	1.6	2.1
1B	-	-	-	3 / 1	1.3	0	-	-	-
0.08	43 / 40	2	0.3	1 / 1	0		20 / 16	0.9	0.9
2B	235 / 211	2.8	0.5	24 / 21	1.3	0.1	49 / 38	1.3	1.8
3A-N	26 / 22	3.5	1.2	16 / 11	7	0.2	48 / 28	1.4	1.1
3A-S	25 / 25	1.3	0.3	15 / 12	0.2	0	51 / 37	0.5	0.3
3B-N	192 / 185	2.8	0.5	25 / 22	3	0.2	140 / 114	0.5	0.4
3B-S	36 / 35	2.5	0.1	14 / 10	0.3	0	53 / 44	0.3	0.2
0.167	12 / 11	5.3	0.1	12 / 11	0.4	0	126 / 18	0.2	0.1
4B	25 / 23	3.4	0.4	7 / 4	1.6	0	53 / 46	0.2	0.1
0.208	48 / 43	4.1	0.3	5 / 5	6.7	0.5	21 / 11	0.2	1.1
5B	5 / 5	0.3	1.1	24 / 15	4.5	0.2	1 / 1	0	0
0.25	61 / 59	4.3	1.6	32 / 27	3.2	0.3	17 / 11	2.4	4.1
6B	126 / 113	3.5	1.1	39 / 28	10	0.5	68 / 49	0.9	3
0.292	201 / 144	3.6	0.8	42 / 31	4.2	0.8	85 / 65	0.8	1.4
7B	19 / 19	4.6	1.2	14 / 13	4.1	0.6	3 / 6	1.7	1.5
0.333	3 / 2	0.8	5	52 / 17	4.4	0.1	1 / 0	1	-
8B	6 / 4	1.6	0.6	35 / 13	4.8	0.1	-	-	-
0.375	5 / 4	0.8	1.4	24 / 11	7.8	1	-	-	-
9B	5 / 4	2.5	0.3	12 / 4	4	0.1	-	-	-
Total	1078 / 954	3.1	0.7	406 / 266	4.3	0.3	757 / 504	0.7	1

[1] For map of crop districts, see Reference 5.
[2] Number tested for *Ascochyta*/Number tested for *Botrytis*.

CROP: Field Pea (*Pisum sativum* L.)

LOCATION: Southern Alberta

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TITLE: THE OCCURRENCE OF MYCOSPHAERELLA BLIGHT, POWDERY MILDEW AND ROOT ROT ON FIELD PEA IN SOUTHERN ALBERTA IN 1999

METHODS: Ten commercial fields of pea were sampled in late August for root rot (*Fusarium* spp., *Pythium* spp., *Rhizoctonia solani* Kühn), mycosphaerella blight [*Mycosphaerella pinodes* (Berk. & Bloxam) Vestergren] and powdery mildew (*Erysiphe pisi* Syd.) diseases (Table 1). Ten plants were collected from small fields (0.1 ha) and 20 plants were collected from large fields for laboratory analysis. The plants were selected at five equally spaced sites along the arms of a "W" sampling pattern in each field. Roots were washed and root rot severity was estimated visually on the samples by using the following scale: 0 = no root rot, 1 = 1-10% root discoloration, 2 = 11-25% root discoloration, 3 = 26-50% root discoloration, and 4 = > 51% root discoloration. Basal stem and root pieces from each field were surface sterilized in 1% NaOCl for 2 minutes, rinsed three times in sterile distilled water and plated onto acidified potato dextrose agar to determine the types of microorganisms present (Table 2). The leaves were assessed for mycosphaerella blight and powdery mildew severity based on scales developed by Xue and Burnett (2).

RESULTS AND COMMENTS: Root rot was found in 8 of the 10 fields surveyed (Table 1). The disease severity ranged from 0.1 to 2.3 and averaged 1.7. The major microorganisms isolated from diseased roots were *Fusarium* spp. followed by *Gliocladium* spp., *Rhizopus* spp. and *Alternaria* spp. (Table 2). Other microorganisms found in minor amounts were *Aspergillus* spp., *Botrytis* spp., *Pythium* spp., *Rhizoctonia solani*, and *Sclerotinia sclerotiorum*. Nematodes were also isolated from root samples at Taber (59%) and Crossfield (22%).

Mycosphaerella blight was found in all fields surveyed. Disease severity ranged from 4.1 to 7.0 and averaged 6.0, slightly lower than the mean disease level found in 1998 (1). Powdery mildew occurred in 8 of 10 fields. The range of mildew severity was from 0 to 5.9, with a mean of 1.1, a very light infection level. The disease was present in southern Alberta in 1998 and prevalent in the Grassy Lake area this year (1).

The most severe disease on field pea in 1999 was mycosphaerella blight, followed by root rot. Powdery mildew infection was generally light in most fields surveyed, but was heavier in fields containing marrowfat peas, probably because of their late maturity.

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Table 1. Severity of root rot, mycosphaerella blight and powdery mildew on pea fields from six locations in southern Alberta in 1999

Location	No. fields surveyed	Seed type	Disease severity		
			Root rot (0-4)	MB (0-9)[a]	PM (0-9)[b]
Crossfield	3	Green	1.8 (1.2-2.2)[c]	6.2 (5.6-7.0)	0
Grassy Lake	2	Marrowfat	-[d]	4.9 (4.1-5.7)	5.2 (4.4-5.9)
Olds	1	Green	0.1	4.7	0
Strathmore	2	Yellow	2.2 (2.0-2.3)	6.2 (6.1-6.2)	0.1 (0-0.2)
Strathmore	1	Green	2.1	5.0	0
Taber	1	Marrowfat	1.8	6.3	2.5

[a] Mycosphaerella blight
[b] Powdery mildew
[c] Number within brackets are ranges of disease severity.
[d] Root samples were not taken from these fields as roots were too dry and brittle.

Table 2. Microorganisms isolated from root samples from eight fields of pea in southern Alberta in 1999.

% Microorganism isolated from root samples [a]	Field location							
	Crossfield			Olds area	Strathmore			Taber
Fusarium spp.	98	100	100	30	100	100	100	96
Gliocladium spp.	0	40	44	20	45	76	90	0
Rhizopus spp.	4	14	8	30	10	34	18	22
Alternaria spp.	38	12	20	0	27	20	8	8
Bacteria	6	6	24	10	10	0	6	52
Nematodes	0	8	22	0	2	10	8	50
Penicillium spp.	14	4	16	0	10	16	4	24
Pythium spp.	12	18	6	0	0	12	8	0
Trichoderma spp.	0	2	0	0	3	6	6	20
Rhizoctonia solani	0	4	2	0	0	4	8	0
S. scleotierum[b]	0	4	14	0	0	0	4	0
Botrytis spp.	0	4	18	0	0	0	0	0
Aspergillus spp.	0	0	0	0	0	0	0	12
Unknown	2	0	0	0	0	0	0	10

[a] The average percentage of roots from each field containing each microorganism (five sampling sites/field and 10 roots/sampling site).

[b] *Sclerotinia sclerotiorum*

CROP: Field pea (*Pisum sativum* L.)

LOCATION: Alberta

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TITLE: DISEASES OF FIELD PEA IN EAST-CENTRAL ALBERTA IN 1999

METHODS: Two disease surveys of field pea were conducted in northeastern Alberta in July and August, 1999, at the flowering and pod-fill stages, respectively. The July survey covered the Municipal District of Sturgeon and seven counties, including Lamont, Minburn, Parkland, St. Paul, Two Hills, Vermilion River and Wetaskiwin (Fig. 1). The August survey covered Lamont, St Paul, Two Hills and Vermilion River. Eighteen field locations were surveyed in July and 25 were surveyed in August. In both surveys, five plants were sampled at each of four random sites for each field and incidence of foliar and root diseases was assessed. The severity of ascochyta blight was evaluated in August by combining disease ratings from upper, middle and lower leaves and stems of each plant using a scale of 0 (no disease) to 4 (over 75% of leaf or stem blighted). Plant samples from all surveyed fields were collected and blighted tissue was cultured on water agar and acidified potato dextrose agar plates in the laboratory to recover pathogens.

RESULTS AND COMMENTS: Ascochyta blight (*Ascochyta* spp.) was found in nine of the 18 fields surveyed in July and 20 of the 25 fields surveyed in August (Table 1). Overall disease severity was below 0.5, and most lesions were located on lower leaves and stems (Table 2). Overall ascochyta blight incidence and severity were at much lower levels than observed in 1998 (Wang et al., 1999).

Powdery mildew (*Erysiphe pisi)* was the most prevalent disease observed during the August survey; it was found in 22 of 25 fields surveyed. Twelve of these fields had a severe infestation. Sclerotinia stem rot (*Sclerotinia sclerotiorum*) and alternaria leaf spot (*Alternaria* spp.) were identified in eleven and seven fields in July and August, respectively, although their severity levels were quite low and neither caused serious damage to pea yields or quality. Root rot, caused by *Fusarium solani* and *Pythium* spp. was common in both surveys. Fusarium wilt (*Fusarium oxysporum*) was also identified in three fields, but the incidence was very low (Table 1).

At two field locations root rots were associated with infection by root-lesion nematodes (*Pratylenchus* spp.). *Fusarium* spp. were also isolated from the same diseased roots. The relationship of nematodes and *Fusarium* in the development of root rot on field oea in Alberta has yet to be determined.

ACKNOWLEDGEMENT: The assistance of Terry Buss, Kirsty Piquette and Randy Bjorklund of Alberta Agriculture, Food and Rural Development in conducting this survey is gratefully appreciated.

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Table 1. Summary of foliar and root diseases identified from pea fields in east-central Alberta in 1999.

DISEASE	CAUSAL PATHOGEN	NO. FIELDS INFESTED	DISEASE INCIDENCE (%)[z]
July survey:			
Fusarium wilt	*Fusarium oxysporum*	1	5
Fusarium root rot	*Fusarium solani*	7	10 - 25
Pythium root rot	*Pythium* spp.	5	5 - 15
August survey:			
Sclerotinia stem rot	*Sclerotinia sclerotiorum*	11	5 - 20
Alternaria leaf spot	*Alternaria* spp.	7	20 - 40
Fusarium wilt	*Fusarium oxysporum*	3	5 - 10
Fusarium root rot	*Fusarium solani*	9	10 - 35
Pythium root rot	*Pythium* spp.	2	5 - 20
Root lesion nematodes	*Pratylenchus* spp.	2	10 - 30

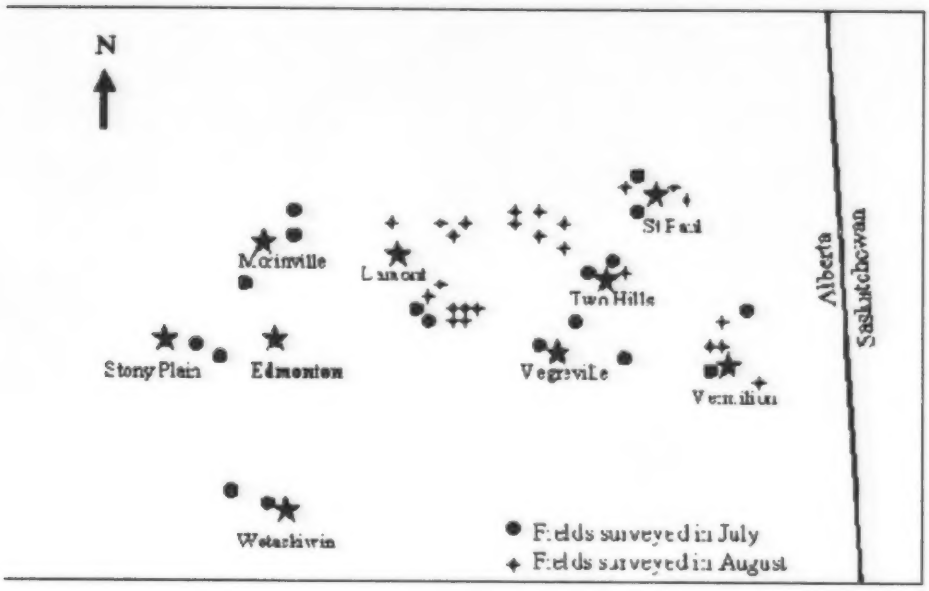
[z] Disease incidence in infested fields surveyed.

Table 2. Severity and lesion distribution of ascochyta blight on field pea samples from east-central Alberta in August,1999.

COUNTY	NO. FIELDS INFESTED/ SURVEYED	DISEASE SEVERITY[z] (0 - 4)	MEAN LESION DISTRIBUTION ON PLANTS (%)			
			Upper	Middle	Lower	Stem
Lamont	9 / 11	0.5 (0.2 – 1.0)	2	17	53	28
Two Hills	5 / 7	0.5 (0.3 – 0.7)	0	15	52	34
Vermilion River	2 / 4	0.3 (0.2 – 0.3)	0	0	54	46
St Paul	1 / 3	0.2	0	0	39	62

[z] Disease severity is the average mean % lesion distribution on the upper, middle and lower leaves and stem of each plant surveyed using a scale of 0 (no disease) to 4 (over 75% of leaf or stem infested with ascochyta blight) with range in brackets.

Figure 1. Distribution of surveyed pea fields in east-central Alberta in 1999. (Each dot or cross on the map represents one field.)



CROP: Field pea

LOCATION: Manitoba

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TITLE: DISEASES OF FIELD PEA IN MANITOBA IN 1999

METHODS: Crops of field pea were surveyed for root diseases at 19 different locations and for foliar diseases at 21 locations in Manitoba. The survey for root diseases was conducted in the last week of June when the plants were at the 8 to 12 node stages, and for foliar diseases in the third week of July when the plants were at the pod-fill to early maturity stages. The crops surveyed were chosen at random from regions in south-west and south-central Manitoba, where most field pea is grown. Ten plants were sampled at each of three random sites for each crop surveyed. Diseases were identified by symptoms. Fusarium wilt and sclerotinia rot were rated as percentage of plants infected. The severity of other diseases observed was estimated using a scale of 0 (no disease) to 9 (whole roots/plants severely diseased). Five to ten roots with disease symptoms per field were collected for isolation of fungi in the laboratory in order to confirm the visual assessment.

RESULTS AND COMMENTS: Root rots were observed in all nineteen fields surveyed and a total of five diseases were recorded (Table 1). Of the five diseases, aphanomyces root rot (*Aphanomyces euteiches*) was the most prevalent and observed in five of the 19 fields surveyed. Severity of aphanomyces root rot for the five infected crops ranged from 2.1 to 7.2 on the 0-9 scale. An overall yield reduction of 10% was estimated for these infected crops. Fusarium root rot (*Fusarium solani* f.sp. *pisi*) and rhizoctonia root rot (*Rhizoctonia solani*) were each observed in six fields, but at low severities. Fusarium wilt (*Fusarium oxysporum* f.sp. *pisi*) was observed in four fields and infection ranged from 1 to 3%. Pythium root rot (*Pythium* spp.) was observed in one field only, with a severity of 3.2. Except for aphanomyes root rot, none of the root diseases appeared to cause significant damage to the pea crops.

Six foliar diseases were observed in the 21 fields surveyed (Table 2). Mycosphaerella blight (*Mycosphaerella pinodes*) and powdery mildew (*Erysiphe pisi*) were the most prevalent diseases, observed in 21 and 18 fields, respectively. Severe disease (Intensity >6.0) caused by mycosphaerella blight was observed in nine crops, and by powdery mildew in seven crops. Yield reduction was estimated as at least 15% when either disease was severe. Sclerotinia stem rot (*Sclerotinia sclerotiorum*) was observed in three fields and infection ranged from 10 to 20%. Other diseases including bacterial blight (*Pseudomonas syringae* pv. *pisi*), septoria leaf blotch (*Septoria pisi*), and anthracnose (*Colletotrichum pisi*), were observed in five, seven and three of the crops, respectively. Severity of these diseases was low and did not appear to cause significant damage to the pea crops.

The Manitoba Agriculture Crop Diagnostic Centre received 15 samples of field pea. Of these samples, 6 were root rot caused by *Fusarium* spp. and *Rhizoctania solani*, 2 mycosphaerella blight, 1 sclerotinia stem rot, and 6 environmental damage.

Table 1. Intensity of root diseases in 20 crops of field pea in Manitoba in 1999.

DISEASE	No. fields affected	DISEASE INTENSITY IN AFFECTED FIELDS*	
		Mean	Range
Aphanomyces root rot	5	3.8	2.1 - 7.2
Fusarium root rot	6	2.1	0.5 - 3.6
Fusarium wilt (%)	4	1.7	1.0 - 3.0
Pythium root rot	1	3.2	3.2
Rhizoctonia root rot	6	1.8	0.1 - 3.0

*Fusarium wilt was rated as percent plants infected: other diseases were rated on a scale of 0 (no disease) to 9 (whole roots/low stem severely diseased).

Table 2. Intensity of foliar diseases in 21 crops of field pea in Manitoba in 1999.

DISEASE	No. fields affected	DISEASE INTENSITY IN AFFECTED FIELDS*	
		Mean	Range
Anthracnose	3	1	1
Bacterial blight	8	1.8	1 - 2.5
Mycosphaerella blight	21	5.2	1 - 8
Powdery mildew	18	5.5	3 - 8
Sclerotinia rot (%)	3	13.3	1 - 20
Septoria leaf blotch	7	1.9	1 - 3

*Sclerotinia stem rot was rated as percent plants infected; other diseases were rated on a scale of 0 (no disease) to 9 (whole plant severely diseased).

CROP: Sunflower

LOCATION: Manitoba

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TITLE: DISEASES OF SUNFLOWER IN MANITOBA IN 1999

METHODS: Thirty eight sunflower crops in southern Manitoba and two crops in southeastern Saskatchewan were surveyed in 1999. Seventy three percent of the crops were confectionery hybrids and 27% were oilseed hybrids. Eleven crops were surveyed during the third week of August, 20 in the first week of September, and nine in the third week of September. Crops were surveyed along preplanned routes in the major areas of sunflower production. Each crop was sampled by two persons walking 100 m in opposite directions in the field following an "M" pattern. Diseases were identified by symptoms and the percent incidence of downy mildew (*Plasmopara halstedii*), sclerotinia wilt or head and stem infections (*Sclerotinia sclerotiorum*), rhizopus head rot (*Rhizopus spp.*), and verticillium wilt (*Verticillium dahliae*) were estimated. Disease severity for rust (*Puccinia helianthi*), leaf spots (*Septoria helianthi* and *Alternaria spp.*), powdery mildew (*Erysiphe cichoracearum*) and stem infections (*Phoma spp. & Phomopsis spp.*) were measured as percent leaf and stem area infected. A disease index was calculated for each disease in every crop based on disease incidence or disease severity (Table 1).

In addition, 41 samples of sunflower plants were submitted for analysis to the Manitoba Agriculture Crop Diagnostic Centre by agricultural representatives and growers.

RESULTS AND COMMENTS: Eighty percent of the sunflower crops surveyed in 1999 had excellent to good stands and vigour, and only 20% had moderate stand and vigour. Twenty percent of the crops were seeded late and were expected to mature very late. Growing conditions were generally good except for abnormally wet conditions at seeding time in southwestern Manitoba and southeastern Saskatchewan which resulted in late seeding in several fields. Several crops in the Red River valley were infested by sunflower midge (*Contarinia schulzi*), however, the severity of infestation was lower than in 1998 (1).

Sclerotinia diseases were more prevalent in 1999 than in 1998 (1). Sclerotinia wilt/basal stem infection was present in 93% of the crops surveyed, with incidence ranging from trace to 10% infected plants (Table 1). Sclerotinia head rot and mid-stem breakage caused by ascospore infections were present in 88% of the crops surveyed with incidence ranging from trace to 20% infected plants. Visits to some sunflower crops in southern Manitoba towards the end of September revealed higher incidences of head rot than observed earlier during the August/early September survey.

Verticillium wilt was present in 88% of the crops surveyed, with incidence ranging from trace to 10% (Table 1). The prevalence and incidence of verticillium wilt in 1999 was higher than in previous years (1, 2) due perhaps to the increased acreage of confectionery hybrids which are susceptible to this disease.

Although downy mildew was observed in 65% of the crops surveyed, the incidence was very low (trace to 1%) in most crops and only up to 5% in a few crops (Table 1). This is the third consecutive year where dry soil conditions and above normal soil temperatures at the seedling stage may have contributed to low incidence of downy mildew. The use of Apron-treated seed for downy mildew control also probably reduced the incidence of the disease in spite of the identification in preliminary investigations of downy mildew isolates with tolerance to metalaxyl.

Rust was present in 60% of the crops surveyed, with severity ranging from trace to 5% leaf area affected in most crops and up to 20% in two crops south of Portage la Prairie (Table 1). The incidence and severity of rust were higher in 1999 than the levels recorded in the last several years in southern Manitoba (1, 2).

Traces to 10% leaf area covered by spots caused by *Septoria helianthi* and *Alternaria spp.* were observed in 63% of crops surveyed in 1999. Phoma stem lesions were present in 38% of the crops at trace to 10% stem area affected (Table 1). Trace levels of phomopsis stem lesions were observed in a few crops. Traces to 5% leaf area affected by powdery mildew were observed in four crops towards the end of the season.

Of the 41 samples submitted to the Manitoba Agriculture Crop Diagnostic Centre, two samples were identified as root rot caused by *Fusarium spp.*, one sample as wilt caused by *Sclerotinia sclerotiorum*, and four samples as alternaria leaf spot caused by *A. zinniae*. In addition to diseases, 28 samples were affected by herbicide injury, and 6 samples were affected by various environmental factors.

ACKNOWLEDGEMENTS: The assistance of L. J. Wiebe in conducting this survey is gratefully acknowledged.

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Table 1. Prevalence and intensity of sunflower diseases in southern Manitoba and southeastern Saskatchewan in 1999.

Disease	Crops affected		Disease index*	
	No.	%	Mean	Range
Sclerotinia wilt	37	93%	0.8	T-2
Sclerotinia head rot/stem rot	28	70%	1.2	T-3
Verticillium wilt	35	88%	0.9	T-3
Downy mildew	26	65%	0.8	T-2
Rust	24	60%	0.8	T-3
Septoria leaf spot	25	63%	1.2	T-2
Powdery mildew	4	10%	1.2	T-2
Phoma stem lesions	15	38%	1.5	T-3
Phomopsis stem lesions	2	5%	1.0	T-1
Stage	n/a		1.9	1-4
Stand	n/a		1.2	1-2
Vigour	n/a		1.3	1-2

* Disease index is based on a scale of 1 to 5: Trace (T) = < 1%, 1= 1% to 5% disease, 2= 5% to 20% disease, 3= 20% to 40% disease, 4= 40% to 60% disease, and 5= greater than 60% disease levels. Index is based on disease incidence for downy mildew, verticillium wilt, and sclerotinia infections; and on disease severity measured as percent leaf area affected for rust and leaf spots. Indexes for stage, stand, and vigour are based on 1-5 scale (1= early/very good and 5= late/very poor).

CROP: Valerian (*Valeriana officinalis* L.)

LOCATION: Alberta and Saskatchewan

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TITLE: SURVEY OF ASTER YELLOWS ON VALERIAN IN ALBERTA AND SASKATCHEWAN IN 1999

INTRODUCTION AND METHODS: Valerian, a herb of European origin, has gradually become popular as an alternative crop in the prairie provinces of Canada. Aster yellows was observed on this plant in Alberta in 1997 (1, 2), but no aster yellows surveys have been conducted on this crop in Alberta or Saskatchewan. Infected crops do not produce seeds, and may be subject to winter kill or soilborne pathogen infection. In 1999, valerian at four locations in Saskatchewan (each consisting of four 5 x 10 m^2 experimental plots) and two locations in Alberta (two commercial field crops at Morinville and three 3 x 6 m^2 experimental plots at Brooks) were surveyed for the disease between early and mid-September. The 1-yr-old crop at Morinville consisted of 16 rows with 110 plants per row in a 17 x 55 m^2 plot area and was surveyed in four equal replicates. The 2-yr-old crop was planted in 30 rows of 110 plants and was surveyed in three equal replicates. All plants were visually checked for symptoms. Disease incidence was calculated by dividing the number of diseased plants by the total number of plants surveyed and calculating a percentage.

RESULTS AND DISCUSSION: Aster yellows of valerian was found at all locations surveyed (Table 1). One-year-old diseased plants showed symptoms of leaf yellowing and reddening and plant stunting. The disease incidence varied considerably with location and ranged from 5 to 91.7% on the 1-year-old crops in Saskatchewan. The highest incidence occurred at Prince Albert, where the crop was surrounded by forage grasses. In Alberta, the disease was quite severe on second-year crops with incidence ranging from 90 to 100%. Phyllody appeared on infected second- or third-year crops. In Brooks, multiple shoots emerged from the ground after a second-year crop was harvested in August. Control measures for aster yellows need to be developed if valerian is to become a viable commercial crop in Alberta and Saskatchewan.

ACKNOWLEDGMENTS: Financial support was partially provided through a grant from the Alberta Agricultural Research Institute, Edmonton.

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Table 1. Incidence of aster yellows in crops of valerian at six locations in Alberta and Saskatchewan, 1999

Location	Crop age (yr)	No. plants examined	Disease incidence (%)	
			Range	Mean
Aberdeen, SK	1	300	10.0 - 20.0	14.7
Saskatoon, SK	1	300	5.0 - 43.3	25.3
Moose Jaw, SK	1	300	28.3 -61.7	45
Prince Albert, SK	1	300	80.0 - 91.7	83.7
Morinville, AB	1	2660	25.2 - 68.3	37.5
Morinville, AB	2	3300	91.8 - 100	97
Brooks, AB	2	240	90.0 - 100	97.2

VEGETABLES / LÉGUMES

CROP: Potato (*Solanum tuberosum* L.)

LOCATION: Alberta

NAME AND AGENCY:
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TITLE: A SURVEY FOR EARLY BLIGHT DISEASE IN POTATO FIELDS OF ALBERTA IN 1999.

METHODS: In August 1999, 104 potato fields from the northern, central and southern potato growing regions of Alberta were examined for evidence of brown lesions with concentric rings characteristic of early blight, caused by *Alternaria solani* Sorauer. Isolates of *A. solani* recovered from diseased leaves from each site confirmed visual observations. Fields with a few small lesions on isolated plants were categorized as having low, fields with large numbers of lesions on many plants as having moderate, and fields where whole leaves and stems were completely necrotic as having high levels of the disease. Observations from the survey are summarized in Table 1.

RESULTS AND COMMENTS: Early blight disease was present in all three potato growing areas of Alberta and it was observed in every field surveyed. The disease has always been present in Alberta but in recent years it has been observed to cause significant economic losses in some fields. Ironically, since the early 1990's the majority of potato fields have received protective fungicide applications for the control of late blight disease caused by *Phytophthora infestans* Mont. (de Bary), and fungicides used to control this disease are also registered for control of early blight. More than 90% of the fields surveyed in this study received at least one fungicide application, and most received more than one. The disease was found on all potato cultivars and was present at different severities (Table 1). The data indicated that the majority (61%) of fields planted with cultivar Russet Burbank developed only low levels of disease. Differences in disease severity in different fields planted with the same cultivar may have been caused by variations in levels of inoculum, plant maturity, nutritional status, local environmental conditions, and production methods, including application of fungicides and irrigation.

ACKNOWLEDGEMENTS: Thanks are extended to the Potato Growers of Alberta and the Alberta Agricultural Research Institute for funding this work.

Table 1. Severity of early blight on different potato cultivars in Alberta.

	Number of fields in various severity categories		
Cultivar*	**Low**	**Moderate**	**High**
Norland	1	2	1
Russet Burbank	32	12	8
Russet Norkotah	2	5	4
Shepody	0	3	2
Snowdon	2	4	1
Bintje	2	0	3
Niska	0	2	2

* Only cultivars with a minimum of four fields surveyed are included in this table.

CROP: Potato (*Solanum tuberosum* L.)

LOCATION: Canada

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TITLE: CROSS-CANADA POTATO LATE BLIGHT SURVEY IN 1998

METHODS: In 1998, 340 samples of potato and tomato suspected of having late blight were received from all provinces. Isolates of *Phytophthora infestans* (de Bary) were prepared in pure culture and studied for mating type and metalaxyl sensitivity, according to Peters (3) and Peters et al. (4), and for glucose phosphate isomerase (*Gpi*) allozyme patterns according to Goodwin et al. (2). Metalaxyl sensitivity was based on 100 µg/ml metalaxyl in the medium, according to Peters (3).

RESULTS: The recovery of active late blight from samples was higher in 1998 (81%) than in 1997 (60%) (1). About 50%, 100%, 71%, 92%, 100%, 46%, 72%, 98%, and 100% of the samples received from Alberta (AB), Manitoba (MB), New Brunswick (NB), Newfoundland (NF), Nova Scotia (NS), Ontario (ON), Prince Edward Island (PE), Quebec (PQ), and Saskatchewan (SK), respectively, were infected by *P. infestans* (Table 1). From British Columbia (BC), we received isolates as pure cultures. Many of the samples were also infected by species of *Verticillium, Botrytis, Alternaria, Fusarium, or Rhizoctonia.*

The A2 mating type was found in all Canadian provinces and represented 98.9% of the total isolates collected (versus 1.1% for A1). The A1 mating type was found in BC and PQ only. Among the 548 isolates tested for resistance to metalaxyl, 77.6 % were sensitive to metalaxyl (MS), 21.3 % were moderately resistant (MI) and 1.1 % were highly resistant (MR). As in the previous year, this study showed a general decrease in resistance to metalaxyl of Canadian A2 mating type isolates compared to those tested in 1996 and 1997, using the same metalaxyl concentration (100 µg/ml). Among A1 mating type isolates, three had the 100:100:111 *Gpi*-allozyme genotype (characteristic of US-11), and were MR, while two had the 100:111:122 Gpi genotype (characteristic of US-8), and were MS (Table 2). Among A2 mating type isolates, different Gpi genotypes were found, but most of them had the 100:111:122 genotype (characteristic of US-8), and were either MS or MI (Table 2). These two combinations (A2/100:111:122/MS and A2/100:111:122/MI) were found in samples from all provinces (Table 2). Pathogenicity tests showed the presence of highly complex physiologic races among genotype 100:111:122 isolates, with almost all virulence genes present, and high levels of aggressiveness (Table 3). On the other hand, tested isolates from Gpi 100:100:111 infected only differentials carrying genes 1, 2, 4, 6, and 7, and were in general either non pathogenic or mildly aggressive to these differentials.

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Table 1. Total and late blight-infected potato samples received from across Canada in 1998.

PROVINCES	TOTAL RECEIVED	LATE BLIGHT-INFECTED (%)
ALBERTA	6	3 (50)
BRITISH COLUMBIA*	17	17 (100)
MANITOBA	16	16 (100)
NEW BRUNSWICK	21	16 (71)
NEWFOUNDLAND	12	11 (92)
NOVA SCOTIA	13	13 (100)
ONTARIO	13	6 (46)
PRINCE EDWARD ISLAND	160	115 (72)
QUEBEC	80	78 (98)
SASKATCHEWAN	4	4 (100)
Total	342	279 (81)

*Received as pure cultures.

Table 2. Distribution of different populations of *Phytophthora infestans* in Canadian provinces in 1998

PHENOTYPES*	# OF ISOLATES	CANADIAN PROVINCES
A1, 100:100:111, MI	1	BC
A1, 100:100:111, MR	3	BC
A1, 100:111:122, MS	2	PQ
A2, 100:111:122, MS	432	AB, BC, MB, NB, NF, NS, PE, PQ, SK
A2, 100:111:122, MI	106	AB, BC, MB, NB, NF, NS, PE, PQ, SK
A2, 100:111:122:, MR	3	PE, PQ
A2, 100:111, MI	1	PQ
A2, 111:122, MS	1	PE
A2, 100:122, MI	1	PE

* Determined by mating type, glucose phosphate isomerase *(Gpi)* genotype, and resistance to metalaxyl, respectively. A1 and A2 represent mating types. Gpi genotypes: 100:100:111 (US-11), 100:111:122 (US-8), 100:111 (US-7), 111:122 (US-10), 100:122 (US-14). MS, MI, and MR: sensitive, moderately, and highly resistant to metalaxyl, respectively.

Table 3. Summary of virulence and aggressiveness of the main genotypes of *Phytophthora infestans* collected in Canada in 1998.

MATING TYPE	GPI GENOTYPE	VIRULENCE GENES[¶]	AGGRESSIVENESS[§]
A1	100:100:111*	1, 2, 4, 6, 7	NP, MA
	100:111:122**	1, 2, 3, 4, 6, 7, 9, 10, 11	HA
A2	100:111:122**	1, 2, 3, 4, 6, 7, 9, 10, 11	MA, HA

[¶] Virulence genes as detected in tested isolates by success of infection against potato differentials carrying individual corresponding resistance genes

[§] Levels of aggressiveness found among tested isolates. NP: non pathogenic, MA: mildly aggressive, HA: highly aggressive.

* Characteristic of US-11

** Characteristic of US-8

CROP: Potato (*Solanum tuberosum*)

LOCATION: Saskatchewan

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TITLE: DISEASES OF STORED POTATOES IN SASKATCHEWAN IN 1998/99

INTRODUCTION: Producers of seed and table-stock potatoes in Saskatchewan consider black scurf, caused by *Rhizoctonia solani*, common scab caused by *Streptomyces scabies*, and dry rot, caused by *Fusarium* species, to be the most significant causes of loss by either rot, or downgrading of the potato crop. A preliminary disease survey of potatoes in storage was conducted in 1997/98 to assess the incidence of tuber-borne pathogens. The results indicated that dry rot and black scurf infections occurred frequently, often at significant levels. Common scab and soft rot (*Erwinia* spp.) were occasional problems. The incidence of silver scurf (*Helminthosporium solani*) was higher than anticipated, as producers had not commented on the occurrence of this disease. A more detailed survey was conducted in 1998/99 to assess both incidence and severity of diseases occurring on stored potatoes.

METHODS: In 1998, 37 samples of tubers harvested in the fall were provided by 12 producers. These samples, from both seed and table-stock, consisted of approximately 100 tubers, collected at random from storage bins. The samples covered a range of cultivars, with the seed samples ranging from elite 1 to elite 4 status. A sub-sample of 30 tubers was selected at random from each sample; the tubers were washed, allowed to dry, and visually evaluated for dry rot, black scurf, common scab, and soft rot. The tubers were then incubated under moist conditions in plastic boxes, at room temperature, for 3 weeks, before evaluation of silver scurf infection. Scab, black scurf and silver scurf were rated for incidence as percentage of tubers infected in the sub-sample and for severity on each tuber, using the rating scales provided by the Canadian Food Inspection Agency. Disease severity ratings were divided into three categories: 1) trace (<1%), 2) 1-5% surface infected, 3) >5% surface infected. The incidence of dry rot and soft rot were also recorded.

In 1997/98, disease assessments were conducted once, in the February-April period, but in the 1998/99 survey, samples were obtained early in the storage season, and three assessments were carried out, the first in October- January, the second in February-March and the third in May. In a few cases there were insufficient tubers for the third assessment. Disease incidence was based on the assessment of 30 tubers in most cases. Disease severity ratings for the three sampling times were combined (total of 90 tubers), and the percentage of tubers that fell into each of the three categories was recorded for each sample submitted.

Isolates of *Fusarium* species were obtained from rotted tubers, and a preliminary assessment of resistance to the fungicide Mertect (active ingredient, thiabendazole) was also conducted. Mertect is currently recommended for control of dry rot and silver scurf, but resistance to the fungicide has been reported in Alberta (2, 3) and the United States (1). Isolates were grown on potato-dextrose agar plates with 0, 5, 10 and 100mg/L of thiabendazole added to the medium. Growth on all plates was compared when the isolate had grown to the edge of the control (no thiabendazole) plate. Isolates that did not grow at 5mg/L were considered sensitive to the fungicide, isolates that showed only slight reduction in growth at 5 and 10mg/L and were able to grow at 100mg/L were considered resistant to the fungicide.

RESULTS AND CONCLUSIONS: In the 1998/99 survey, 24 % of the 37 samples evaluated had no dry rot infections (in the total 90 tubers), 46% of the samples had a low incidence of dry rot (1-5% of the 90 tubers infected), and 30% of the samples had more than 5% of the tubers infected (Table 1). Time of disease assessment affected the level of dry rot observed in the sample, with increased incidence of dry rot being noted in the latter half of the storage season (Table 2).

Significant levels of black scurf were recorded in the survey. Low disease severity (0 or <1% surface infected on all tubers) was observed on 11% of the 37 samples, 30% of the samples had all tubers with 5% or less of the surface infected, and 59% of the samples had some tubers with more than 5% of the surface infected (Table 3). Timing of assessment did not appear to affect the levels of disease recorded (Table 2).

The incidence and severity of silver scurf (Table 3) were higher than recorded in 1997/98. Sixty-five percent of the 37 samples had some tubers with more than 5% of the surface area infected. Timing of assessment affected the evaluation of silver scurf, with a marked increase in levels observed at the third date (Table 2). This is consistent with producer observations that silver scurf is not noticeable until tubers come out of storage, at the end of the season. The increase in levels of silver scurf and dry rot, noted later in the storage season, could significantly affect reporting of the disease status of a tuber sample at any particular time.

Soft rot occurred in 54% of samples after incubation for 3 weeks, but was not likely to be a problem under cool commercial storage conditions. The average disease incidence was 6%, with a range of 1-16%. Similarly, common scab was not considered a general problem, although it occurred on 32% of the samples. The average incidence was 14 % (range of 1-54%).

Twenty-four *Fusarium* isolates (*F. sambucinum* type) obtained from rotted tubers produced at six locations in Saskatchewan were tested for resistance to Mertect. Three locations had both sensitive and resistant isolates present, two locations had only resistant isolates, and one location had only sensitive isolates, with a total of 67% of the isolates being resistant to the fungicide (Table 4). This incidence of resistant isolates is similar to that reported in Alberta in 1994 (3).

ACKNOWLEDGEMENTS: We wish to thank the potato producers of Saskatchewan for providing tuber samples, and Janet Weller for technical assistance. Financial support from the Agri-Food Innovation Fund and Agriculture Development Fund is gratefully acknowledged.

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Table 1. Distribution of dry rot incidence* in 37 samples of stored potatoes in Saskatchewan in 1998/99.

Percentage of samples showing:		
No disease	1-5% tubers infected	>5% tubers infected
24	46	30

*Values are based on pooled results from 3 sampling periods (i.e. 90 tubers per sample in most cases).

Table 2. Incidence of diseases on stored potatoes in relation to time of assessment, in 1998/99.

Sampling period	Average disease incidence (% tubers infected)*		
	Dry rot	Black scurf	Silver scurf
Oct-Jan	4	34	27
Feb-March	16	46	22
May	16	36	56

* based on total number of samples rated in each sampling period

Table 3. Severity of black scurf and silver scurf on stored potatoes in Saskatchewan in 1998/99.

Disease	Percentage of samples in disease category:		
	0 or <1%	5% or less	>5%
Black scurf	11	30	59
Silver scurf	13	22	65

Table 4. Sensitivity of 24 *F. sambucinum* isolates to thiabendazole.

Location	No. of isolates	
	sensitive	resistant
1	2	4
2	2	0
3	0	4
4	2	3
5	2	1
6	0	4

FRUIT, NUTS and BERRIES, ORNAMENTALS and TURFGRASS,/ FRUITS, FRUITS À ÉCALE, et BAIES, PLANTES ORNEMENTALES et GAZON

CROP: Saskatoon, *Amelanchier alnifolia*

LOCATION: Alberta

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TITLE: **SURVEY OF BROWN ROT AND MUMMY BERRY AND CYTOSPORA DIEBACK AND CANKER DISEASES OF SASKATOON IN ALBERTA IN 1999.**

INTRODUCTION AND METHODS: Cytospora dieback and canker caused by *Cytospora leucostoma*, and brown rot and mummy berry caused by *Monilinia amelanchieris* on saskatoon (*Amelanchier alnifolia*) can cause significant economic losses in fruit production under environmental conditions that are conducive for the development of these diseases. There are no fungicides registered in Canada to control these diseases. They are frequently observed on saskatoon bushes in Alberta orchards; however, no systematic survey of these diseases has been conducted since 1990 (1). In 1999, surveys were conducted to determine the incidence and severity of these diseases in commercial saskatoon orchards. A minimum of three orchards each in the Peace River (northern), Edmonton (central), and Calgary (southern) regions were surveyed.

Incidence of cytospora dieback and canker in an orchard was assessed by determining the number of bushes showing typical symptoms including dieback of twigs and branches, and wrinkling, vertical splitting and exfoliation of stems. Isolates of *C. leucostoma* recovered from diseased samples at each site confirmed visual observations. The survey for cytospora dieback and canker was conducted in the second, third and fourth weeks of June in central, southern and northern Alberta orchards, respectively. Disease severity on a scale of 1 to 5 was determined by assessing the number of stems of main branches showing infection on each of the bushes surveyed.

Incidence of brown rot was determined by counting berries showing typical symptoms, including discoloration and brown spots showing felty fungal growth. The survey for brown rot was conducted in the third week of June in orchards of the central and southern regions, and during the fourth week of June in the northern region orchards. Isolates of *M. amelanchieris* recovered from diseased samples from each site confirmed visual observations.

RESULTS AND DISCUSSION: Cytospora canker was found in every orchard, and, except for one orchard, 79 - 100% of the bushes were infected (Table 1). Incidence of the disease on main stems in the central Alberta orchards was lower than that on main stems of saskatoon bushes in orchards in the other two regions. Infection of main stems seriously affects plant vitality.

Brown rot was also found in every region surveyed. Average incidence of the disease on berries and berry bunches in northern and central regions ranged from 8.8 to 21.6% and 31.2 to 70.8%, respectively (Table 2), whereas, in the southern region it ranged from 0.1 - 7.2%. Drier weather during flowering in southern Alberta could have been one of the reasons for lower disease development.

ACKNOWLEDGEMENT: We thank the Fruit Growers Society of Alberta, Alberta Horticultural Congress, and Alberta Agricultural Research Institute for funding this work.

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Table 1. Incidence and severity of cytospora canker in commercial saskatoon orchards in Alberta in 1999.

Orchard location	Disease incidence (%)	Main stems infected (%)	Bushes in each severity category (%)[y]					Cytospora canker disease index[z]
			1	2	3	4	5	
Northern-1	100	32.3	0	7	27	42	24	5.8
Northern-2	97	17.9	3	10	28	45	14	5.2
Northern-3	100	39.3	0	8	36	38	18	5.4
Central-1	97	–	3	31	46	15	5	3.5
Central-2	100	4.7	0	1	4	27	68	7.8
Central-3	26	2.7	74	18	4	2	2	0.7
Central-4	79	7.2	21	30	26	14	9	3.0
Southern-1	95	15.7	15	20	45	16	4	3.3
Southern-2	85	10.4	10	7	34	25	24	5.0
Southern-3	90	14.0	5	2	15	29	49	6.7

[x] Incidence and severity of the disease in an orchard was assessed on 100 bushes in five randomly selected sets of 20 bushes each.

[y] Severity of the disease on a bush was categorized by counting number of main branches showing infection: 1 = no visible infection, 2 = 1 - 25, 3 = 26 - 50, 4 = 51 - 75, 5 = 76 - 100% main branches infected.

[z] Disease index for an orchard was calculated by dividing the sum of products of incidence and mid point severity value for each severity category by 1000.

– Data were not taken.

Table 2. Incidence of brown rot disease in commercial saskatoon orchards in Alberta in 1999[x].

Orchard location	Berries infected (%)	Berry bunches infected (%)
Northern-1	18.2	64
Northern-2	21.6	59.6
Northern-3	10	38.4
Central-1	8.8	31.2
Central-2	21	70.8
Central-3	11.9	49.2
Central-4	3.4	20.4
Southern-1	1.4	7.2
Southern-2	0.1	0.4
Southern-3	0.8	3.6

[x]Incidence of brown rot was determined by counting number of infected berries and berry bunches. Each orchard was surveyed using five replications. Each replication consisted of 50 berry bunches collected from five adjacent bushes.

CROP: Saskatoon, *Amelanchier alnifolia* (Nutt.)

LOCATION: Alberta

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TITLE: SURVEY OF BLACK LEAF AND WITCHES' BROOM AND SASKATOON-JUNIPER RUST DISEASES OF SASKATOON IN ALBERTA IN 1999.

INTRODUCTION AND METHODS: Black leaf and witches' broom (*Apiosporina collinsii*) and saskatoon-juniper rust (*Gymnosporangium* spp.) diseases of saskatoon cause significant economic losses in many saskatoon orchards in Alberta. Overall spread and severity of these diseases, however, have not been studied for many years. In 1999, surveys were conducted to determine the incidence and severity of these diseases in commercial saskatoon orchards in Alberta. A minimum of three saskatoon orchard each in the Peace River (northern), Edmonton (central), and Calgary (southern) regions of Alberta were surveyed.

Incidence and severity of black leaf and witches' broom in each orchard was determined by monitoring for downward rolling of leaves, presence of black, felt-like fungal growth on the underside of these leaves, and proliferation of branches (witches' broom). Incidence and severity of saskatoon-juniper rust in an orchard was determined by observing typical symptoms of the disease, including yellowish orange lesions and spiny projections on leaves and berries. Surveys for both of these diseases in the central, southern, and northern region saskatoon orchards were conducted in the first, second and third weeks of July, respectively.

RESULTS AND DISCUSSION: Saskatoon bushes in eight out of 11 orchards were infected with black leaf and witches' broom disease (Table 1). The disease was not found in two central and one southern Alberta orchard, whereas two other central and one southern orchard showed very high levels of the disease. Incidence of the disease (number of bushes showing infection) ranged from 0 to 91%, and, of these, three orchards had 5, 10 and 70% bushes with four or more main stems infected with the disease. Once established in an orchard, this disease is very difficult to control. The pathogen produces large amounts of inoculum, and every spring there is new wood available for infection. There is currently no fungicide registered in Canada to control black leaf and witches' broom of saskatoon.

Saskatoon rust was found both on leaves and berries in northern and southern Alberta orchards. None of the central Alberta orchards showed any disease during this survey (Table 2). However, rust has been observed previously in this region. Where present, incidence of disease on leaves and berries ranged from 2.3 - 13.2% and 0.3 - 3.3%, respectively, and severity from 1.5 - 1.9 and 3.5 - 10.0%, respectively. Incidence and severity of rust on leaves and berries in this study was very low. A much higher incidence and severity of the disease on leaves of saskatoon was reported earlier from a site in southern Alberta (1). A single spot on a berry makes it unusable for the fresh fruit market. Propiconazole (Topas) is now registered for control of this disease in Canada.

ACKNOWLEDGEMENT: We thank the Fruit Growers Society of Alberta, Alberta Horticultural Congress, and Alberta Agricultural Research Institute for funding this work.

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Table 1. Incidence and severity of black leaf and witches' broom disease in commercial Saskatoon orchards in Alberta in 1999[x].

Orchard location	Bushes infected (%)	Bushes in different severity categories[y] (%)				Black leaf and witches' broom disease index[z]
		1	2	3	4	
Northern - 1	7	93	5	2	0	1.1
Northern - 2	5	95	5	0	0	0.5
Northern - 3	21	79	18	3	0	2.7
Central - 1	59	41	34	20	5	12.4
Central - 2	52	48	35	7	10	11.6
Central - 3	0	100	0	0	0	0.0
Central - 4	0	100	0	0	0	0.0
Southern - 1	3	97	3	0	0	0.3
Southern - 2	0	100	0	0	0	0.0
Southern - 3	5	95	3	2	0	0.9
Southern - 4	91	9	4	4	70	51.4

[x] Incidence and severity of the disease in an orchard was determined by monitoring the disease on 100 bushes in five randomly selected replications of 20 bushes each.

[y] Severity of black leaf and witches' broom was evaluated by counting infection on main branches of a bush. The bushes were assigned to four severity categories; 1 = 0, 2 = 1, 3 = 2-3, and 4 = 4 or more branches infected.

[z] Black leaf and witches' broom disease index for an orchard was calculated by dividing the sum of products of incidence and assigned values for each severity category (1 = 0, 2 = 1, 3 = 3, 4 = 6) by 10.

Table 2. Incidence and severity of rust disease on leaves and berries of saskatoon in commercial orchards in Alberta in 1999[w].

Orchard location	Leaves			Berries		
	Incidence[x] (%)	Severity[y] (%)	Rust index[z]	Incidence[x] (%)	Severity[y] (%)	Rust index[z]
Northern - 1	4.3	1.9	0.9	1.2	9.9	2.0
Northern - 2	2.3	1.7	0.4	0.2	7.7	0.3
Northern - 3	2.0	1.7	0.3	0.3	3.5	0.1
Central - 1	0.0	0.0	0.0	0.0	0.0	0.0
Central - 2	0.0	0.0	0.0	0.0	0.0	0.0
Central - 3	0.0	0.0	0.0	0.0	0.0	0.0
Central - 4	0.0	0.0	0.0	0.0	0.0	0.0
Southern - 1	0.0	0.0	0.0	0.0	0.0	0.0
Southern - 2	13.2	1.6	2.1	3.3	9.0	4.6
Southern - 3	8.1	1.5	1.3	0.5	10.0	0.8

[w] Five replications each of 300 randomly selected leaves and berries from three saskatoon bushes were observed for rust infection in every orchard.
[x] Number of infected leaves or berries.
[y] Horsfall-Barratt disease severity ratings back-transformed to percent area infected.
[z] Rust severity index for an orchard was calculated by dividing the sum of products of incidence and mid-point severity value for every Horsfall-Barratt severity category by 10.

CROP: Juniper

LOCATION: Ontario

NAME AND AGENCY:
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TITLE: JUNIPER RUST SPECIES AT THREE SITES IN ONTARIO, 1999

INTRODUCTION: In 1998, we found three rust species on cultivars of *Juniperus scopulorum* at a nursery in south-central Ontario: *Gymnosporangium clavipes*, *G. globosum* and *G. juniperi-virginianae* (Hsiang and Richter 1999). The purpose of this work was to examine the occurrence of rust species at three locations in Ontario on a wider variety of juniper species and cultivars.

METHODS: In May 1999, juniper rust was assessed at a nursery near Georgetown, Ontario, at the University of Guelph Arboretum, and at the Royal Botanical Gardens near Burlington, Ontario. Almost 200 juniper plants were examined. Each tree was inspected for at least five minutes to inventory all rust infections. The number of infections by each rust species and the height and location of each tree were recorded. A few samples were brought back to the lab to confirm the rust species based on microscopic features (summarized in Hsiang and Richter, 1999).

RESULTS AND DISCUSSION: A total of 192 juniper plants were examined among six species of junipers at the three locations in southern Ontario (Table 1). No galls of *G. juniperi-virginianae* were found on any juniper plants in 1999. At the Georgetown location, no rust was found on cultivars of *J. chinensis* which is in agreement with last year's findings (Hsiang and Richter 1999). However, at both the Burlington and Guelph locations, rust was found on certain cultivars of *J. chinensis*: *G. globosum* on 'Spartan' and 'Rose Arbour', and *G. clavipes* on 'Sea Green' and 'Spartan'. Tisserat and Pair (1997) have previously reported that *G. juniperi-virginianae* was found at a low level on *J. chinensis* cultivars.

At the Guelph location, one plant of *J. communis* 'Suecica' showed one gall of *G. clavipes*, and one plant of *J. horizontalis* 'Hughes' had 2 galls of *G. clavipes*. No rust was found on *J. sabina* or *J. squamata* at the Burlington and Guelph sites. As with the previous year, *J. scopulorum* 'Moffettii', 'Skyrocket', and 'Wichita Blue' had the highest incidence of *G. clavipes* and *G. globosum*, while 'Grey Gleam' had the lowest incidence of rust among the *J. scopulorum* cultivars.

These results indicate that rust incidence did not vary greatly between 1998 and 1999 at the Georgetown location, but there were some minor differences among the three locations.

ACKNOWLEDGEMENTS: We wish to thank the Nursery in Georgetown, the Royal Botanical Gardens in Burlington and the Arboretum at the University of Guelph for their permission to study junipers in their collections.

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Tisserat, N.A. and J.C. Pair. 1997. Susceptibility of selected juniper cultivars to cedar-apple rust, Kabatina tip blight, Cercospora needle blight and Botryosphaeria canker. J. Environ. Hort. 15:160-163.

Table 1. Incidence and severity of *Gymnosporangium* rusts on *Juniperus* cultivars at three sites in southern Ontario in May 1999.

JUNIPERUS SPECIES	CULTIVAR	NO.	*G. clavipes*		*G. globosum*		*G. juniperi -virginianae*		AVERAGE HEIGHT (cm)
			incid[a]	sever[b]	incid	sever	incid	sever	
Burlington									
chinensis	Old Gold	8	0%	-	0%	-	0%	-	75
chinensis	Sea Green	9	44%	+	0%	-	0%	-	100
chinensis	Spartan	14	100%	++	100%	+++	0%	-	90
sabina	several	17	0%	-	0%	-	0%	-	62
scopulorum	several	16	94%	++	100%	+++	0%	-	154
squamata	Blue Carpet	10	0%	-	0%	-	0%	-	29
Georgetown									
scopulorum	Gray Gleam	10	20%	+	50%	+	0%	-	125
scopulorum	Greenspire	10	20%	+	80%	+	0%	-	150
scopulorum	Medora	10	30%	+	100%	+	0%	-	154
scopulorum	Moffetii	10	100%	++	100%	++	0%	-	178
scopulorum	Skyrocket	10	100%	++	100%	+	0%	-	185
scopulorum	Wichita Blue	10	100%	+	90%	++	0%	-	208
Guelph									
chinensis	several	16	0%	-	6%[c]	+++	0%	-	190
communis	several	12	8%[d]	+	0%	-	0%	-	251
horizontalis	several	9	11%[e]	+	100%	++	0%	-	35
sabina	several	8	0%	-	0%	-	0%	-	62
scopulorum	several	5	100%	+	100%	++	0%	-	400
squamata	several	8	0%	-	0%	-	0%	-	223

[a] incid is incidence of the disease calculated as the percentage of plants showing rust infections.
[b] sever is the severity of the disease on plants showing disease where '-' = no disease, '+' = 1 to 10 galls/plant, '++' = 11 to 100 galls/plant and '+++' = 101 to 1000 galls/plant.
[c] *J. chinensis* 'Rose Arbour'
[d] *J. communis* 'Suecica'
[e] *J. horizontalis* 'Hughes'

CROP: Apple

LOCATION: British Columbia

NAME AND AGENCY:
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TITLE: POSTHARVEST DECAY OF STORED APPLES IN BRITISH COLUMBIA IN 1998

INTRODUCTION: Almost half of the apples harvested from British Columbia's primary apple growing areas of the Okanagan and Similkameen Valleys are placed in large cold storage rooms located at the seven major packinghouses. The fruit is then removed from cold storage and packed well into the spring, ending when all the fruit is sold. The fruit destined to be kept the longest is put into controlled atmosphere storage where temperature, and oxygen and carbon dioxide concentration are rigorously controlled. Relatively new apple cultivars such as 'Braeburn' and 'Gala' are being tested to determine the optimum storage conditions for keeping them, as well as some of the older cultivars such as 'McIntosh'. The apple industry in British Columbia through the Okanagan Federated Shippers Association (OFSA) maintains a research program that has the responsibility of determining these conditions. In cooperation with OFSA we surveyed the apples from the various growing areas that were being tested, for postharvest decay. Usually the decay is caused by either *Penicillium* spp. or *Botrytis cinerea*, as we found in an earlier survey on rotten fruit from three packinghouses (Sholberg and Haag, 1995). The *Penicillium* spp. are made up of several species with *P. expansum* the most common, comprising about 80% of the isolates. *Penicillium crustosum* is likely the second most important species although it is considered a weak pathogen of apple compared to *P. expansum*. *Penicillium* spp. cause the postharvest disease known as blue mold in which conidia originating from decayed fruit infect wounds during harvest and handling (Jones and Aldwinckle, 1990). *B. cinerea* causes the postharvest disease known as gray mold. Similarly, conidia of *B. cinerea* infect wounds or injuries on apples during harvest and handling of fruit going into storage (Jones and Aldwinckle, 1990). In addition to this type of infection, *B. cinerea* may also infect apples during development in the orchard and later cause gray mold in storage (Jones and Sutton, 1996). Species of *Alternaria* also cause apple decay, particularly *A. alternata*. This fungus infects fruit through weak or injured tissue (Jones and Aldwinckle, 1990). Therefore, all postharvest decays are much more common on injured fruit. Factors that predispose fruit to decay in storage are over-maturity and natural openings such as growth cracks or open calyxes. The fruit in this study were picked at optimum maturity so maturity was not thought to be a factor.

METHODS: Apples picked at optimum maturity were placed in rigorously controlled storages at the Pacific Agri-food Research Centre (PARC), Summerland in the fall of 1997. Controlled atmosphere (CA) storage conditions varied among cultivars (Table 1). During the spring of 1998, the fruit were removed from storage, evaluated for quality and any that appeared to show signs of decay were removed. These fruit were moved to the plant pathology laboratory and examined for postharvest decay. Isolations were made from apples that appeared to be infected by *Penicillium* spp. and where the causal organism was in doubt. Isolations were made by removing the fruit skin from the margin of a lesion and aseptically placing bits of decayed tissue on Petri plates containing potato dextrose agar. After incubation at 20°C for 5 to 14 days isolates were identified as a species of *Penicillium* or some other postharvest pathogen based on colony morphology and spore characteristics.

RESULTS: 'Braeburn' apples were very susceptible to postharvest decay in 1998 with 27.8% decay in air storage when fruit from all areas were combined (Table 1). Controlled atmosphere storage of 'Braeburn' reduced decay at least 6% depending on the type of CA. *Penicillium* spp. were the most important cause of decay in air storage causing roughly twice as much decay as *B. cinerea*, however in the CA storage with elevated levels of carbon dioxide, *B. cinerea* was the most important cause of decay. 'Braeburn' apples from the more northern apple growing areas in Vernon and Kelowna, B.C., were much more resistant to postharvest decay in air storage than those from more southern areas. 'Gala' apples stored for 5 and 9 months were also very susceptible to decay in 1998 (Table 2). It was rather unusual that more decay occurred in CA storage than in air storage. Decay caused by *Penicillium* spp. was much higher than decay caused by *B. cinerea* in fruit stored for 5 months but was almost equal in fruit stored in air for 9 months. 'McIntosh' apples were strongly affected by storage regime (Table 3). The CA storage with elevated temperature of 3.0°C and relatively high CO_2 led to extremely high levels of decay. *Penicillium* spp. were by far the most important cause of decay in both air and CA stored 'McIntosh' apples.

DISCUSSION: It was clear from this survey that postharvest decay was a significant problem in 1998 for stored apples. It appears that the new apple cultivar, 'Braeburn', is subject to decay if kept in storage for 6 months. CA storage is very important in reducing losses, especially of 'Braeburn'. 'Braeburn' was less prone to decay if grown in more northern regions but unfortunately does not always reach maturity in these areas. It also appears that 'Gala' is very susceptible to decay when stored for 5 or more months. *Botrytis cinerea* was an important pathogen of 'Gala' and could have infected the fruit before harvest. Dry eye rot caused by *B. cinerea* was common in 'Gala' orchards in B.C. in 1997 and the high incidence of this fungus in the 'Gala' storage trials may be evidence of this infection. 'McIntosh' is very susceptible to decay in storage because the fruit are very easy to injure. This was supported by the high degree of McIntosh apples that were infected by *Penicillium* spp. However storage conditions are very important in predisposing apples to fungal decay. Warmer storage conditions have a very pronounced effect on decay, increasing it several fold as shown when 'McIntosh' was stored at 3.0 rather than 1.7°C. Relatively high levels of carbon dioxide will reduce decay as was the case when 'McIntosh' was stored at 5% CO_2, however high carbon dioxide can lead to off flavours.

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Table 1. Postharvest decay of 'Braeburn' apples stored for 6 months at three storage regimes.

Site Location	Number of Sites*	Pathogen	Percent apples decayed in storage		
			Air**	CA1***	CA2****
Vernon, B.C. area	3	*Penicillium* spp.	0	2.6	0
		Alternaria spp.	4.5	0	0
		Combined	4.5	2.6	0
Kelowna, B.C. area	4	*B. cinerea*	1.8	11.1	10.6
		Penicillium spp.	1.9	8.6	4.5
		Combined	3.7	19.7	15.1
Summerland, B.C. area	7	*B. cinerea*	10.3	10.5	17.3
		Penicillium spp.	22.2	8.3	10.2
		Alternaria spp.	7.8	0.7	0.6
		Combined	40.3	9	28.1
Osoyoos and Cawston, B.C. Areas	5	*B. cinerea*	13.5	2.8	18
		Penicillium spp.	30.1	19.1	8
		Alternaria spp.	0	0	3
		Combined	43.6	21.9	29
All Areas (Based on the total number of apples, 1235)	19	*B. cinerea*	7.7	6.9	13.3
		Penicillium spp.	16.5	10.3	6.8
		Alternaria spp.	3.6	0.2	1
		Combined	27.8	17.4	21.1

*Number of sites refers to the number of locations where 195 apples were harvested per location at optimum maturity and separated into lots of 65 for each storage regime.
**Air storage was at 0°C with 21.0% oxygen and 0.2% carbon dioxide.
***CA1 storage was at 0°C with 1.5% oxygen and 0.2% carbon dioxide.
****CA2 storage was at 0°C with 1.5% oxygen and 1.2% carbon dioxide.

Table 2. Postharvest decay of 'Gala' apples stored for 5 and 9 months at two storage regimes.

Site Location	Number of Sites*	Pathogen	% Decay after 5 months		% Decay after 9 months	
			Air**	CA***	Air	CA
Summerland B.C. Area	3	*B. cinerea*	10.6	10	14.4	11.5
		Penicillium spp.	16.9	21.5	13	16.6
		Alternaria spp.	0	3.2	0	0
		Combined	27.5	34.7	27.4	28.1

*Number of sites refers to the number of locations where 260 apples per location were harvested at optimum maturity and separated into lots of 65 apples for each storage regime and duration.
**Air storage was at 0°C with 21.0% oxygen and 0.2% carbon dioxide.
***CA storage was at 0°C with 1.2% oxygen and 1.5% carbon dioxide.

Table 3. Postharvest decay of 'McIntosh' apples stored for 6 and 9 months at three storage regimes.

Site Location	No. of Sites*	Pathogen	% Decay after 6 months			% Decay after 9 months		
			Air**	CA1***	CA2****	Air	CA1	CA2
Vernon, B.C. Area	3	*B. cinerea*	0.6	0	0	4.2	1.1	0.6
		Penicillium spp	8.2	5	20	12.9	4	38
		Alternaria spp.	0	0	0	0.3	0	0
		Combined	8.8	5	20	17.4	5.1	38

*Number of sites refers to the number of locations where 126 apples per location were harvested at optimum maturity and separated into lots of 21 apples for each storage regime and duration.
**Air storage was at 0°C with 21% oxygen and 0.2% carbon dioxide.
***CA1 was storage at 1.7°C with 2.5% oxygen and 5.0% carbon dioxide.
****CA2 was storage at 3.0°C with 1.2% oxygen and 1.5% carbon dioxide.

FOREST TREES/ ARBRES FORESTIERS

CROP: Forest trees

LOCATION: British Columbia

NAME AND AGENCY:
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TITLE: NEW RECORDS OF PATHOGENS AND DECAY FUNGI ISOLATED FROM SAMPLES SUBMITTED TO THE PACIFIC FORESTRY CENTRE HERBARIUM, 1995-1998.

METHODS: The Pacific Forestry Centre Herbarium (DAVFP) diagnoses diseases and identifies fungi collected by staff or submitted by the Provincial Forest Service, foresters, and naturalists. Each new record below represents one of the following:
NRBC: New provincial record
NHR: New host record (previously found in the province on other hosts or substrates).
NDR: Significant extension of previously known distribution in the province.
Each of the records was confirmed by microscopic examination of fruiting bodies or cultures, and is further substantiated by deposition of a voucher specimen in Herbarium DAVFP. Accession numbers for the herbarium specimens are included in Table 1. The records listed in Table 1 for 1995 are incremental to those published by Van Sickle and Humphreys (1998). Further information on provincial host-fungus records and herbarium accession data are available at the following web site:
http://www.pfc.cfs.nrcan.gc.ca/biodiversity/herbarium

RESULTS: All of the identifications have been pooled and are summarized in Table 1.

REFERENCE:

Van Sickle, G.A., and N. Humphreys, 1998. pp. 57-62 in: Hall, J.P., Bowers, W.W., and Hirvonen, H. Forest insect and disease conditions in Canada 1995. Natural Resources Canada, Canadian Forest Service, Science Branch, Ottawa.

Table 1. Summary of new disease and decay fungus records identified from samples submitted to the Pacific Forestry Centre Herbarium, 1995-1998.

TYPE OF RECORD/ LOCATION (YEAR)	HOST	SYMPTOM/ DISEASE	CAUSAL AGENT	DAVFP NO.
NHR Cowichan Lk., BC (1995)	*Pinus monticola* Dougl.	Dieback associated with tree stress	*Xenomeris abietis* Barr	25117
NHR Appledale, BC (1995)	*Sorbus americana* Marsh.	Butt rot of sapling	*Trametes pubescens* (Schumach.:Fr) Pilát	25156
NRBC Metchosin, BC (1995)	*Populus tremuloides* Michx.var. *vancouverianae*	Decay	*Pseudovalsaria ferruginea* (Nitschke) Rappaz	25434
NRBC Waneta, BC (1995)	Abies grandis (Dougl.) Lindl.	Needle necrosis	*Phyllosticta abietis* Bissett & Palm	25123
NHR Sooke Lake, BC (1996)	*Cytissus scoparius* (L.) Link	Dieback, cankering	*Fusarium sambucinum* Fuckel	25199
NHR Oyster Bay, BC (1996)	*P. tremuloides* var. *vancouveriana*	Decay	*Diatrype flavovirens* (Pers.:Fr.) Fr.	25197
NRBC Sidney, BC (1996)	*Arbutus menziesii* Pursh.	Saprophytic on winter-damaged leaves	*Harknessia arctostaphyli* Cooke & Harkn.	25168
NHR Nelson, BC (1996)	*Prunus* sp.	Decay	*Cerrena unicolor* (Bull.:Fr.) Murrill	25175
NDR Queen Charlotte Islands (1996)	Picea sitchensis (Bong.) Carr.	Root disease	*Armillaria ostoyae* (Rom.) Herink	25247
NHR Metchosin, BC (1998)	*Quercus garryana* Dougl.	Dieback and decay	*Nemania serpens* (Pers.:Fr.) S.F. Gray var. *macrospora* (J.H. Miller)	25426
NHR Metchosin, BC (1998)	*Holodiscus discolor* (Pursh.) Maxim.	Decay	*Hypoxylon fuscum* (Pers.:Fr.) Fr.	25420
NRBC Metchosin, BC (1998)	*Alnus rubra* Bong.	Decay	*Diatrypella verrucaeformis* (Ehrh.:Fr.) Nits.	25421
NRBC Metchosin, BC (1998)	*Prunus emarginata* (Dougl.) Walp.	Dieback and decay	*Biscogniauxia mediterranea* (De Not.) Kuntze var. *microspora* (J.H.	25423
NHR Metchosin, BC (1998)	*Alnus rubra*	Dieback and decay	*B. mediterranea* var. *microspora*	25429

CROP: American Beech

LOCATION: Ontario

NAME AND AGENCY:
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TITLE: BEECH BARK DISEASE IN ONTARIO, 1999

INTRODUCTION: In North America, beech bark disease (BBD) has resulted in the significant loss of American Beech (*Fagus grandifolia* Ehrh.) where the disease has been established for some time (Houston 1994). The disease has been attributed to an introduced fungus, *Nectria coccinea* var. *faginata* Lohm., Wats. & Ayers, although the closely related native species *N. galligena* (Bres.) is also considered to be a causal agent of BBD. The disease is caused by infection of these fungi only after bark damage has been caused by feeding of the scale insect *Cryptococcus fagisuga* Lind.

The insect, and probably the fungus, were accidentally introduced into North America around 1890 on imported ornamental beech trees, appearing first in Nova Scotia in 1920 (Houston 1994). The insect and the fungus subsequently spread, and by 1932 BBD was established throughout the Maritime Provinces, and in localized areas in Maine and eastern Massachusetts. Beech bark disease was first confirmed in Quebec in 1965 (Lachance 1982) and the scale insect and disease have continued to spread northwest across southern Quebec (QMRN 1998).Although confirmed samples of beech bark disease from Ontario have not been previously reported, it has been suggested that the disease has been present in Ontario for some 10 - 15 years (D. Houston, pers. comm.). This paper reports the first confirmed samples of the disease and its approximate distribution.

METHODS: In 1999 surveys were undertaken by the Canadian Forest Service (CFS) and the Ontario Ministry of Natural Resources (OMNR) to confirm the presence of beech bark disease (BBD) and determine its approximate distribution in Ontario. Field technicians acquired locations of forest stands in southern Ontario where American Beech was likely present according to OMNR forest inventory information. Because beech seldom is a major component of these stands, standard survey methodology utilizing transects was not employed. Instead technicians conducted what amounted to a whole stand evaluation searching for beech trees showing signs of disease or decline. Beech trees showing disease symptoms were evaluated for the presence of the disease and the associated insect scale. Bark samples displaying fruiting were removed and submitted to the CFS mycology diagnostic clinic in Sault Ste. Marie. Samples were confirmed as positive or negative based on characteristics of perithecia and related spore and cultural characteristics (Booth 1959, Cotter et al. 1981).

RESULTS AND DISCUSSION: In 1999, ten positive locations with BBD were identified and confirmed in southern Ontario (Fig. 1). *Nectria coccinea* var. *faginata* was found at each location associated with stem cankers on beech trees, and an isolate of *N. galligena* was collected at one location. The first location confirmed was in the southern portion of Murray Township in Hastings County, northwest of the city of Trenton. This represents the first confirmation of BBD in Ontario although it is apparent, given the distribution of the disease, that it has been present for some time. The beech scale insect *C. fagisuga* which is known to precede BBD, has been previously confirmed in Ontario. Bisessar et al. (1985) published the first account of the insect's occurrence in Ontario in 1981. An earlier collection of *C. fagi* (= *C. fagisuga*) was made in 1966 by Forest Insect and Disease Survey (FIDS) near Lake Erie, but was mistakenly reported as a maple bark

scale (Sippell et al. 1966). The insect has been detected at various levels in annual FIDS surveys since 1981, and is now known to be distributed across southern Ontario (Fig. 1). Surveys show that the disease is established across much of southern Ontario (Fig. 1), although the complete distribution is still to be determined. The presence of the scale insect in areas outlying from the disease suggest further spread of BBD.

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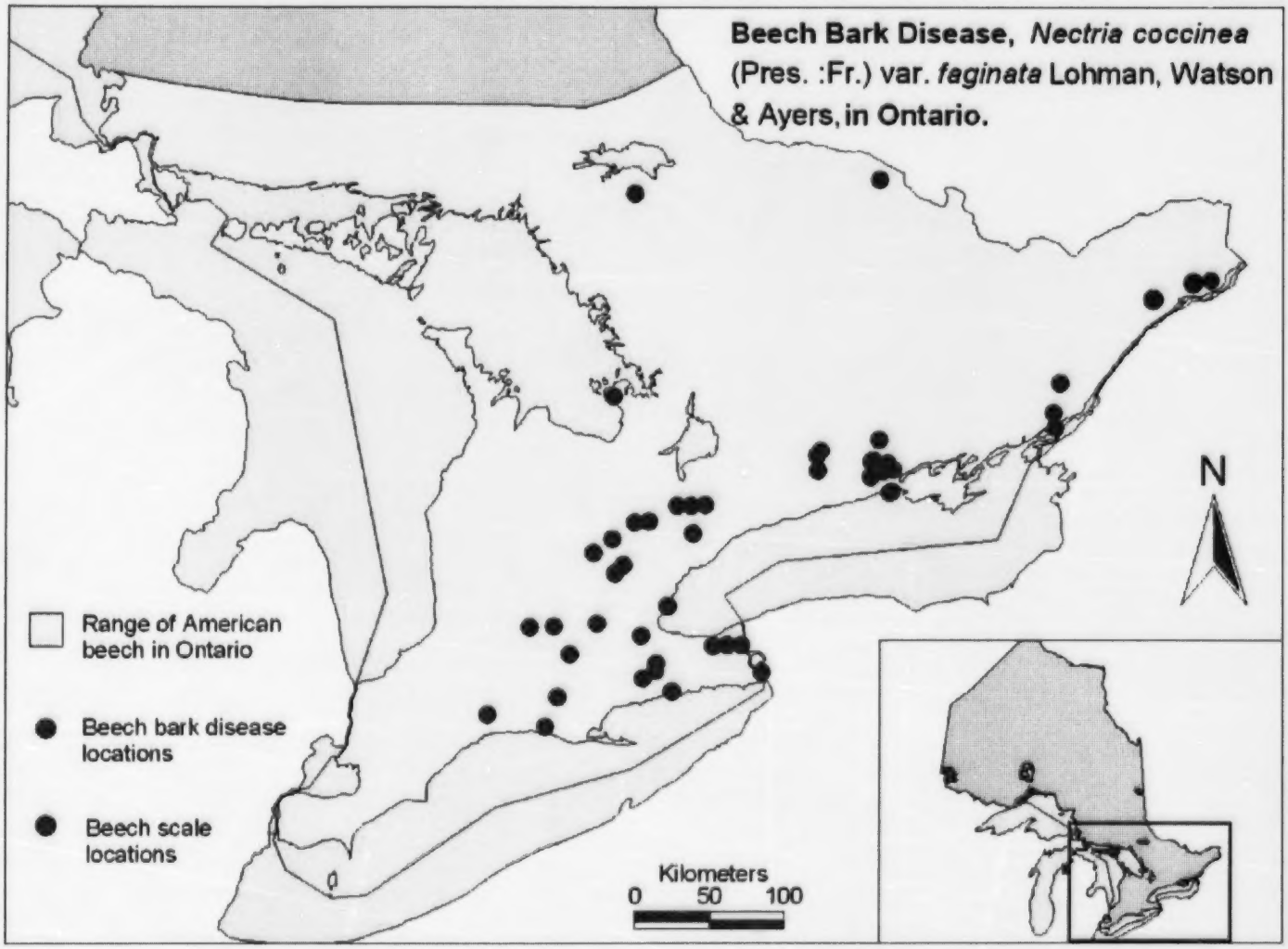
Figure 1. Confirmed locations of beech bark disease (Nectria coccinea var. faginata and N. galligena) collected in 1999 and beech scale (Cryptococcus fagisuga) collected between 1981 and 1999.


Beech Bark Disease, Nectria coccinea (Pres. :Fr.) var. faginata Lohman, Watson & Ayers, in Ontario.
N
Range of American beech in Ontario
Beech bark disease locations
Beech scale locations
Kilometers
0 50 100

CROP: Forest Trees (Eastern Larch, Red Pine, Scots Pine, Jack Pine, Butternut, American Elm)

LOCATION: New Brunswick, Nova Scotia, Prince Edward Island, Newfoundland

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TITLE: **STATUS OF EUROPEAN LARCH CANKER, EUROPEAN RACE OF SCLERODERRIS CANKER, BUTTERNUT CANKER AND DUTCH ELM DISEASE IN ATLANTIC CANADA 1999.**

METHODS: Separate field surveys for each of European larch canker (*Lachnellula willkommii*), European race of scleroderris canker (*Gremmeniella abietina*), butternut canker (*Sirococcus clavigignenti-juglandacearum*) and Dutch elm disease (*Ophiostoma ulmi*) were conducted in selected forest stands with susceptible hosts at the appropriate time for symptom expression. All except butternut canker are under quarantine regulation. European larch canker surveys were conducted in New Brunswick (NB), Nova Scotia (NS), Prince Edward Island (PEI) and Newfoundland (NF) in areas outside of the quarantine regulated areas of the southern half of NB (approximate), mainland NS and part of Prince County, PEI. The European race of scleroderris canker was surveyed in Scots pine and jack pine plantations outside of the regulated area of the Avalon Peninsula in eastern NF and at a Scots pine and a red pine plantation adjacent to a regulated area in northwestern NB. Butternut trees were surveyed at several locations in the watersheds of NB. Dutch elm disease surveys were limited to a few locations in PEI. These surveys were conducted in any or all of the years spanning 1997 to 1999.

RESULTS AND COMMENTS: In Canada, European larch canker is found only in the maritime provinces with a known range of infection that includes portions of each of the maritime provinces which currently define the area under quarantine regulation. For the last several years survey effort has been focused in areas outside the regulated zone. The disease was first found in PEI in 1992 at two sites in Prince County and despite intensive surveys in 1997-1999, no other positive locations have been discovered. In NB, one new location was found just outside the regulated area in 1997. The disease is not known to occur in NF. The distribution of European larch canker is virtually unchanged since a map was published in 1995. Table 1 provides an annual breakdown of survey effort.

The only known locations for the European race of scleroderris canker in Atlantic Canada are limited to eastern NF and northwestern NB (Fig 1). In NF, in 1998 and 1999, a total of 34 locations with Scots, red and jack pine plantations were examined outside the quarantine zone on the Avalon Peninsula. In the fall of 1998, the disease was found in plantations at three locations outside the quarantine zone on Scots pine (*Pinus sylvestris* L.) at Bonavista and Catalina (about 135 km NNE of the quarantine zone), and jack pine (*Pinus banksiana* Lamb.) and Scots pine at Sunnyside on Trinity Bay (about 45 km NW of the quarantine zone). These finds in 1998 resulted in further surveys in 1999 and the disease was identified at a fourth location on planted Scots pine in Come By Chance, near the Sunnyside location detected in 1998. In NB, a single location near Bourgoin, Madawaska County has been intermittently monitored for disease spread since 1988. In 1999, a Scots pine plantation and a red pine plantation within approximately 1.8 km of the original find, were confirmed as infected by the European race of scleroderris canker.

Butternut canker was first discovered in the Maritimes in 1997 at five locations in Carleton County NB. Butternut is at the northeastern limit of its natural range in New Brunswick. No natural butternut occurs in NS, PEI or NF, although scattered individuals are planted as ornamentals and in three small plantations in PEI. Butternut is commonly found as scattered individuals and in small groups among other species of hardwoods, which makes surveying for the disease difficult. In 1998, 21 sites were surveyed in NB and all were negative for the disease, and in 1999, six sites in NB and two plantations in PEI were found to be disease free.

Dutch elm disease was first reported in NB in 1957 at Woodstock, Carleton Co.; in NS in 1969 at Liverpool, Queens Co.; and in PEI in 1979 in Conway, Prince County. Presently the disease occurs throughout the distribution of American elm in NB and has been recorded in all counties of NS except in Digby, Shelburne, Yarmouth and Richmond counties. In NB and NS, the distribution of Dutch elm disease has changed very little since a map was published in 1995(1). The spread of the disease to most of PEI is more recent and thus disease incidence is not as high as in NB and NS. The only new distribution record for PEI for 1999 was in the City of Summerside.

ACKNOWLEDGEMENTS: The authors are grateful for the technical field assistance of Art Doane, Dave O'Brien and Tom Walsh, the planning effort and guidance of Gary Warren at CFS - Corner Brook and support from Wade MacKinnon of the PEI Dept of Agriculture & Forestry. Thanks to Gaston Laflamme and Nicole Lecours of the CFS Laurentian Forestry Centre in Sainte-Foy, Quebec for the scleroderris canker European race determinations.

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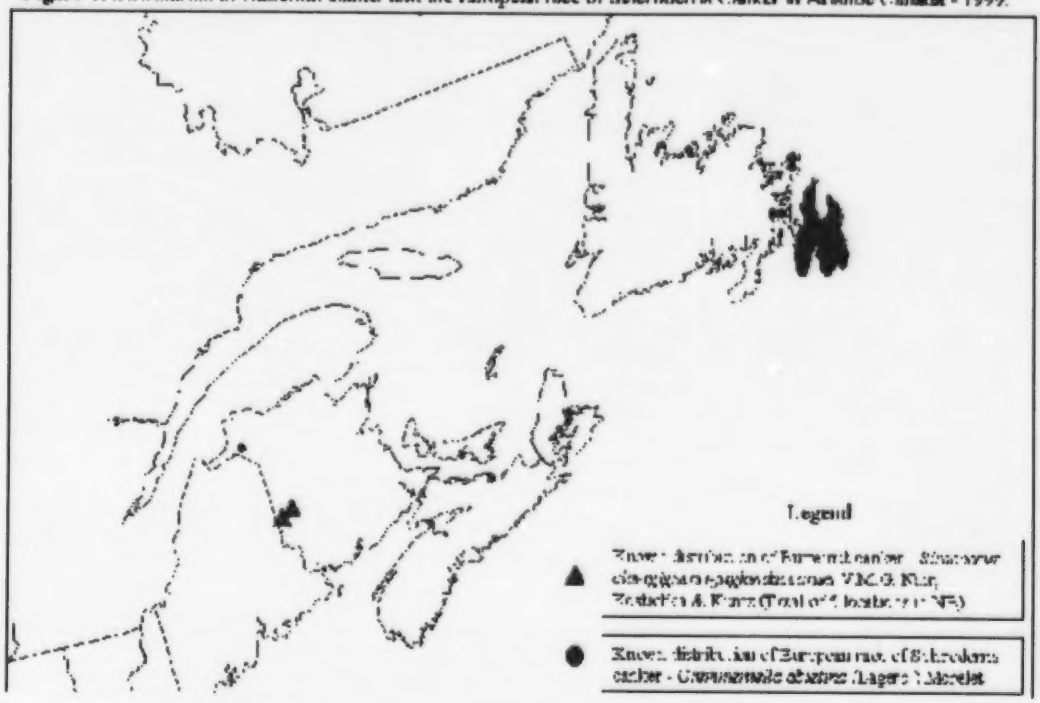
Table 1. The survey effort for European Larch Canker in Atlantic Canada for the period 1997 to 1999.

Province	Number of Locations Surveyed		
	1997	1998	1999
New Brunswick	26	20	21
Nova Scotia	20	34	43
Prince Edward Island	62	60	78
Newfoundland	23	0	0

Figure 1: Distribution of Butternut canker and the European race of Sirococcus Canker in Atlantic Canada - 1999.



CROP: Western hemlock

LOCATION: British Columbia

NAME AND AGENCY:
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TITLE: MYCOFLORA ASSOCIATES OF WESTERN HEMLOCK DWARF MISTLETOE PLANTS AND HOST SWELLINGS COLLECTED FROM SOUTHERN VANCOUVER ISLAND, BRITISH COLUMBIA

INTRODUCTION: The hemlock dwarf mistletoe *Arceuthobium tsugense* (Rosendahl) G.N. Jones parasitizes many economically important conifer species in western Canada and the USA. The effects of the mistletoe subspecies *Arceuthobium tsugense* subsp. *tsugense* on the host *Tsuga heterophylla* (Raf.) Sarg. can be identified in several ways; the presence of dwarf mistletoe shoots, localized swelling of branch or stem tissue with or without the presence of mistletoe shoots, and in severe cases, the formation of witches' broom (a proliferation of twigs on a branch). The most practical way to control *A. tsugense* subsp. *tsugense* is to remove infected trees; clear-cut harvesting can successfully eradicate dwarf mistletoe from a stand. However, alternative management methods for dwarf mistletoe, such as biological control merit investigation. Known fungal parasites of dwarf mistletoes have been isolated and shown to kill shoots and fruits of western hemlock dwarf mistletoe directly (Kope *et al.*, 1997). This survey was done to identify the fungal flora associated with western hemlock dwarf mistletoe from a restricted area within the natural range of western hemlock in BC.

METHODS: Mycoflora associates of western hemlock dwarf mistletoe were collected from southern Vancouver Island during the spring and summer of 1996 and 1997 (Fig. 1). Collections included moribund shoots and fruits of dwarf mistletoe plants, hypertrophic sections of branches, with or without mistletoe plants present, and hypertrophic branches that were cankered and had resinous exudates. Sampled trees ranged from 10 to 50 years of age, and collections were made in the area between ground level and 3 m. Collections were refrigerated at 2°C until examined. Tissue sections from the hypertrophic branches and cankers were cut from the woody tissue underneath the bark. Moribund mistletoe plants and fruits were surface disinfested in 3% NaOH and rinsed in sterile distilled water. The samples were plated onto selective media and purified through successive transfers.

RESULTS AND DISCUSSION: Of the fungi listed in Table 1 all are known to be weakly parasitic or saprophytic fungi, except for *Colletotrichum gloeosporioides* (Penzig) Penzig et Saccardo, *Cylindrocarpon gillii* (Ellis) J.A. Muir and *Nectria neomacrospora* (Wr.) Ouellette (anamorph *Cylindrocarpon cylindroides* Wollenw.) which are known hyperparasites of *Arceuthobium* spp. (Muir, 1967; Kuijt, 1963; Funk *et al.*, 1973). There is a fairly strong presumption that fungal parasites or hyperparasites of *Arceuthobium* spp. are to be found in their corresponding ecological niche on the dwarf mistletoe plant (Funk *et al.* 1973). We suggest further, from the presence of other fungi in association with parasitized *Arceuthobium* spp., that a succession of biological interactions involve the host, parasite and nearly always one or more nonparasite or fungal associate coexisting on or in the host with the parasite. In this study *C. gloeosporioides* and *C. gillii* were isolated from fruits of *A. tsugense* subsp. *tsugense*, whereas *N. neomacrospora* is assumed to parasitize the endophytic system of *Arceuthobium* spp. *Colletotrichum gloeosporioides* affected the fruit of *A. tsugense* subsp. *tsugense* and the affected fruit would fall from the shoots without releasing seed. Interruption of seed dispersal is an effective strategy in controlling spread of dwarf mistletoe. *Cylindrocarpon gillii* was observed and collected for the first time in British Columbia from the fruit of *A. tsugense* subsp. *tsugense* . Affected fruit had white eruptions on their surface and became shriveled and did not release their seeds. Conidial characteristics and measurements are similar to those reported previously by Ellis (1946) for *C. gillii* occurring on dwarf mistletoe shoots and by Muir (1973) on other *Arceuthobium* species. *Nectria neomacrospora* was collected from branch swellings on *T. heterophylla*, and for the first time in British Columbia from *Pinus*

contorta D. Douglas ex Loudon var. *contorta*. On Vancouver Island, it is known that *A. tsugense* subsp. *tsugense*, found on *T. heterophylla*, also parasitizes *P. contorta* var. *contorta* and this mistletoe race shows some host affinity, but at present it does not have a separate taxonomic recognition (Hawksworth and Weins, 1996). Measurements of *N. neomacrospora* asci, ascospores, and the macro- and microconidia of the anamorph *C. cylindroides* were similar for both hosts, however, the perithecia were larger on *P. contorta* var. *contorta*.

ACKNOWLEDGMENTS: This research project was supported by Forest Renewal British Columbia (FRBC - Project # HQ 96244-RE). The authors extend their appreciation to Carmen Oleskevich for her technical support.

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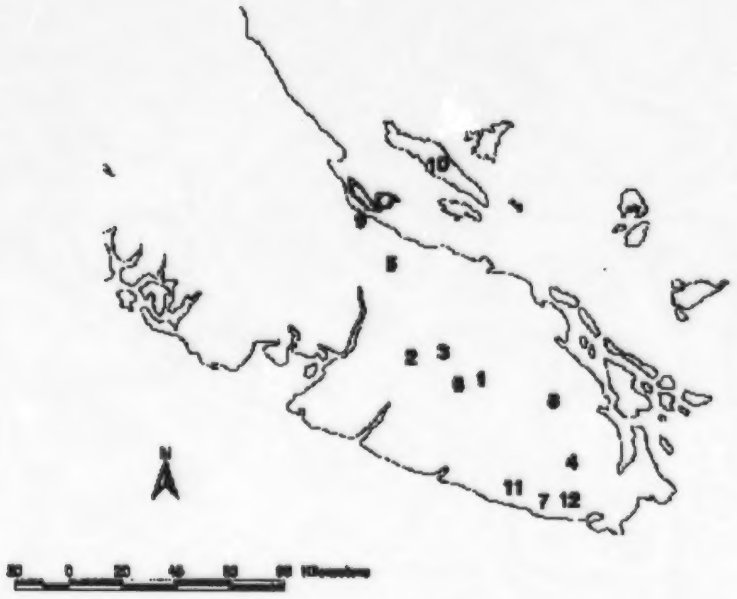
Table 1. Fungi collected from hemlock dwarf mistletoe in southern British Columbia.

Fungi isolated	Location[1]	Number of isolates
Aureobasidium sp.	4	1
Botryosphaeria tsugae Funk	1	2
Colletotrichum gloeosporioides (Penzig) Penzig et Saccardo	3, 5	5
Coniothyrium sp.	1	3
Cylindrocarpon cylindroides Wollenw.	2, 7, 8	11
Cylindrocarpon gillii (Ellis) J.A. Muir	7, 10	3
Epicoccum purpurascens (Ehrenb. ex Schlecht.)	1, 4	5
Fusarium sp.	2, 3	3
Gleosporium sp.	1	1
Hormonema sp.	1, 2, 4	22
Monochaetia sp.	1, 3	3
Mucor sp.	1	2
Nectria neomacrospora (Wr.) Ouellette	2, 5, 7, 8, 9 11, 12	14
Penicillium sp.	1, 2	3
Pestalotiopsis maculans (Corda) Nag Raj	3	13
Phoma sp.	1, 2, 3, 4	22
Phomopsis lokoyae Hahn	1	1
Pithomyces chartarum (Berk.) M.A. Curtis	1	1
Sclerophoma pithyophila (Corda) Hoehn.	1, 2, 3, 4, 6	17
Seimatosporium sp.	4	3
Trichoderma sp.	1, 4	9
Truncatella angustata (Pers.) S.J. Hughes	1, 4	8

Location[1] - (1) - Cowichan Lake, (2) - Nitinat, (3) - Shaw Creek, (4) - Gr. Victoria Watershed, (5) -Horne Lake, (6) - Caycuse Mt., (7) - Shirley, (8) - Holt Creek, (9) - Bowser, (10) - Texada Island, (11) - Jordan River, (12) - Sooke.

Figure 1. Dwarf Mistletoe biocontrol collection sites, Vancouver Island, British Columbia.



CROP: Whitebark pine

LOCATION: British Columbia

NAME AND AGENCY:
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Vancouver Forest Region, British Columbia Ministry of Forests, Nanaimo, British Columbia

TITLE: WHITEBARK PINE AND WHITE PINE BLISTER RUST IN SOUTHWESTERN BRITISH COLUMBIA - 1998

INTRODUCTION: Whitebark pine (*Pinus albicaulis*) is a high elevation conifer species found throughout British Columbia south of 56 N latitude. The future survival of whitebark pine is threatened by its susceptibility to white pine blister rust, an exotic disease caused by the fungus *Cronartium ribicola*. To date, only one survey of whitebark pine has been undertaken in British Columbia (1), even though the species appears to be more frequently attacked than western white pine. Eventually, with a reduction of cone-bearing members in a stand, there will be direct impacts on wildlife species which rely on whitebark pine seed for food (e.g., Clark's nutcracker and grizzly bear), and indirect impacts on wildlife that use the tree for cover.

METHODS: High-elevation stands within the Lillooet, Merritt, and Squamish Forest Districts having a leading or significant component of whitebark pine were identified using the provincial forest inventory database. Once a stand was located, the surveyor visually inspected for rust on the first 50 live and dead whitebark pine trees encountered during a strip transect reconnaissance. Only trees >1.3 m in height were included in the sample of 50.

RESULTS: A total of 69 stands was surveyed. Most stands were located west and southwest of Merritt and north and east of Pemberton. Of the 3450 whitebark pine trees examined, 794 (23%) were dead (Table 1). Mortality on 226 (28.5%) of the dead trees could be directly attributed to white pine blister rust. Due to the difficulty of diagnosing some dead trees, this figure is likely conservative as dead trees without obvious stem cankers were classified as dead due to other factors. These other factors include mountain pine beetle (*Dendroctonus ponderosae*), abiotic site factors, and unknown or unidentified causes.

Of the remaining 2656 live trees, 507 (19.1%) were alive but infected with blister rust. Of these infected trees, 356 (70.2%) had stem cankers and will likely die within a few years. The remaining infected trees displayed branch cankers that may develop into stem cankers over several years. In addition, many trees suffered form defects such as basal sweep, forks, crooks, and damage from cambial feeding by squirrels.

COMMENTS: Future activities include completing the population survey over the rest of the province in the next 2-3 years and identifying potential parent trees for use in resistance testing and tree propagation.

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Table 1. Summary of whitebark pine survey results.

District	No. of	Tree Status							
		Live, Uninfected		Live, Infected by DSB[1]		Dead, from DSB		Dead, Other or Unknown	
Lillooet	2400	1476	61.5%	384	16.0%	168	7.0%	372	15.5%
Merritt	950	638	67.2%	99	10.4%	49	5.2%	164	17.3%
Squamish	100	35	35.0%	24	24.0%	9	9.0%	32	32.0%
Total	3450	2149	62.3%	507	14.7%	226	6.6%	568	16.5%

[1] DSB = white pine blister rust.

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